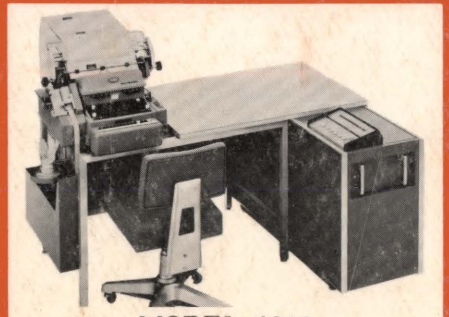
Friden

Technical Manual for

Friden 6010 Electronic Computer



MODEL 6010

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FOREWORD

Business needs a tremendous amount and variety of information to operate effectively. And, as the pace of business quickens, it is imperative that time lags between an event and its appearance in a useful report be minimized. This has probably been the greatest stimulus to the outstanding developments in the fields of automatic computation and electronic data processing in the last few years . . . developments which permit data to be used more and more as a management tool.

The new Friden 6010 Electronic Computer is a low cost unit designed for business applications which require high-speed computations, as well as descriptive alphabetic information. Although comparatively low in cost, the 6010 has many characteristics of larger, more expensive computer systems. Yet the machine takes up no more floor space than a secretary's desk.

Changing jobs on the 6010 is easy because simple programming methods require only sequential wiring on a conventional program panel. Separate panels may be wired for individual applications, or a single panel may be wired for several applications, depending on the complexity of the programs involved.

This manual presents basic concepts and principles as an aid for developing a knowledge of the Friden 6010 Electronic Computer system. Each section is organized to present a logical association of related concepts and operational principles. They may be used in sequence to develop the concept of the 6010 system, or independently as reference material.

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SECTION I
INTRODUCTION

GENERAL

The Friden 6010 Electronic Computer system is a complete small-scale, business oriented computer. This digital computer, with solid-state circuitry, is a desk-size machine which operates as an independent unit. It combines high-speed computation with simultaneous output of printed information; plus coded output of punched paper tape, edge-punched cards, tabulating cards, or any combination of these.

Friden's 6010 Electronic Computer is especially designed for business applications which require accurate, high-speed computations. This unit performs the arithmetic functions of addition, subtraction and multiplication at electronic speeds. In addition, any logical arithmetic operation can be accomplished through programmed subroutines. The 6010 adds in 1.3 milliseconds (one millisecond represents 1/1000 of a second). It also subtracts in 1.3 milliseconds, and multiplies in 50 milliseconds (average). This amounts to instantaneous computation! For example, in one second the 6010 can make over 750 additions - over 45,000 in one minute.

In spite of its low cost, the 6010 has many characteristics of larger, more expensive computer systems. It has individually addressable core storages, and it performs logical functions. It is transistorized, thereby giving maximum reliability. In addition, this unit is equipped with a removable program panel which allows it to be used for more than one application. These advanced electronic techniques, plus other progressive features incorporated into the 6010, provide exceptional flexibility for applications found in small, intermediate and large businesses. Applications include: all types of billing, payroll, statistical quality control, a broad range of accounting applications and many other business operations which require high-speed computation.

SYSTEMS CONFIGURATION

Five main components make up the Friden 6010 Electronic Computer. These are: the input-output unit, control unit, arithmetic unit, storage unit, and the logic unit. With the exception of the input-output unit, all other sections are contained within the Central Processor (see figure 1).

Input-Output Unit. The Friden Flexowriter, Model 6011, provides input-output to the Central Processor. This automatic writing machine allows for both automatic and manual input. Output from the Central Processor is in the form of a typed document and, if desired, a punched tape or cards.

Central Processor. The Central Processor is the control center of the Friden 6010 Electronic Computer system. This unit provides program control, arithmetic processing, logical operations, and input-output control. An operation-display panel, located on the top of the Central Processor, is used by the operator to control the system and monitor its operation. A brief explanation of the components contained within the Central Processor follows:

Control Unit - The control unit of the Central Processor directs and coordinates the functions of the entire computer system. This involves controlling the input-output unit, the arithmetic and logical operations of the Central Processor, and the transferring of data to and from storage.

Storage Unit - The 6010 has both variable and fixed storages. Variable data storages provide 240 decimal digits of storage organized into 15 storages or words of 16 digits each. More than one group of data may be stored in a single storage by programming.

Fixed data storages provide 22 decimal digits of storage capacity organized into

5 storages or words. Any one of these storages will accept a maximum of 16 digits. Fixed storages are used to store constant data for each program.

Arithmetic Unit - This unit performs the operations of addition, subtraction, multiplication, shifting, transferring, storing and clearing. Division is performed by a subroutine.

Logic Unit - This unit gives the 6010 the ability to test various conditions encountered during a program and to take the action called for by the results of these tests.

WIRED PROGRAM

The Friden 6010 Electronic Computer system performs its functions by executing a series of instructions at high speed. Each instruction defines a basic operation to be performed and identifies the storage to be affected or function to be performed to carry out the operation. A series of instructions required to complete a given problem is known as a program.

In the 6010, these instructions are externally wired into a removable program panel. This panel indicates to the control unit the processing requirements for a particular program. Programming then, simply becomes a matter of wiring this panel to set up a series of instructions for the machine to follow in a given program.

Interchangable program panels provide a convenient means of programming the 6010 for a variety of applications. Normally a separate panel is used for each application. The changing of program panels is a simple matter and can always be accomplished in a few seconds.

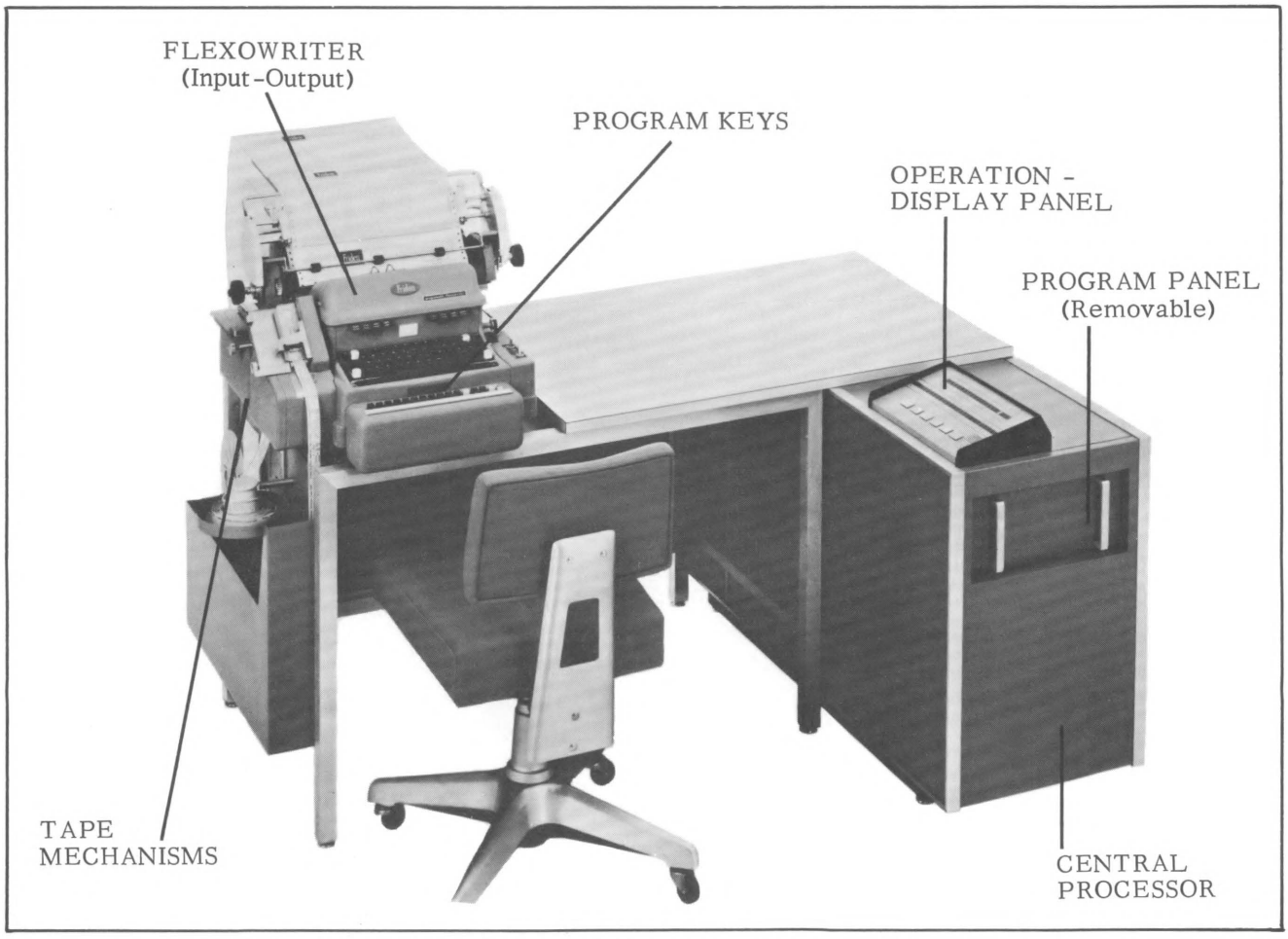


Figure 1. Friden 6010 Electronic Computer System - Basic Components

SECTION II
INPUT-OUTPUT UNIT

GENERAL

The Friden Flexowriter, Model 6011, provides input-output to the Central Processor. This automatic writing machine, available in single or double case, allows for the automatic input of digital information into the 6010 from: punched paper tape, edge-punched cards, or Hollerith coded tabulating cards. It also allows for the manual entry of data into the 6010 from its typewriter-like keyboard. And additional features on this unit permit the cable-connection of auxiliary input as well as output equipment.

The Flexowriter, Model 6011, receives impulses from the Central Processor and types digital or alphabetical data on a document. In addition, this machine also has the ability to automatically produce a punched tape record of any data (both numeric and alphabetic) which is processed on it. The features of the Flexowriter, Model 6011 (single case machine), are described in this section.

FLEXOWRITER COMPONENTS

Five major components make up the Flexowriter, Model 6011. These are: the edge-card reader, code translator, writing machine, code selector and edge-card punch (see figure 2). The operation of these components is described below:

Edge-Card Reader. Mechanically senses codes punched in paper tape or edge-punched cards and converts each code into a series of electrical impulses which are sent to the code translator. The edge-card reader is also capable of transmitting impulses directly to the Central Processor (in a non-print condition), thereby bypassing the action of the code translator.

Code Translator. Converts the electrical impulses from the edge-card reader into a mechanical action which causes a key-lever on the writing machine to be operated, or a function to be performed.

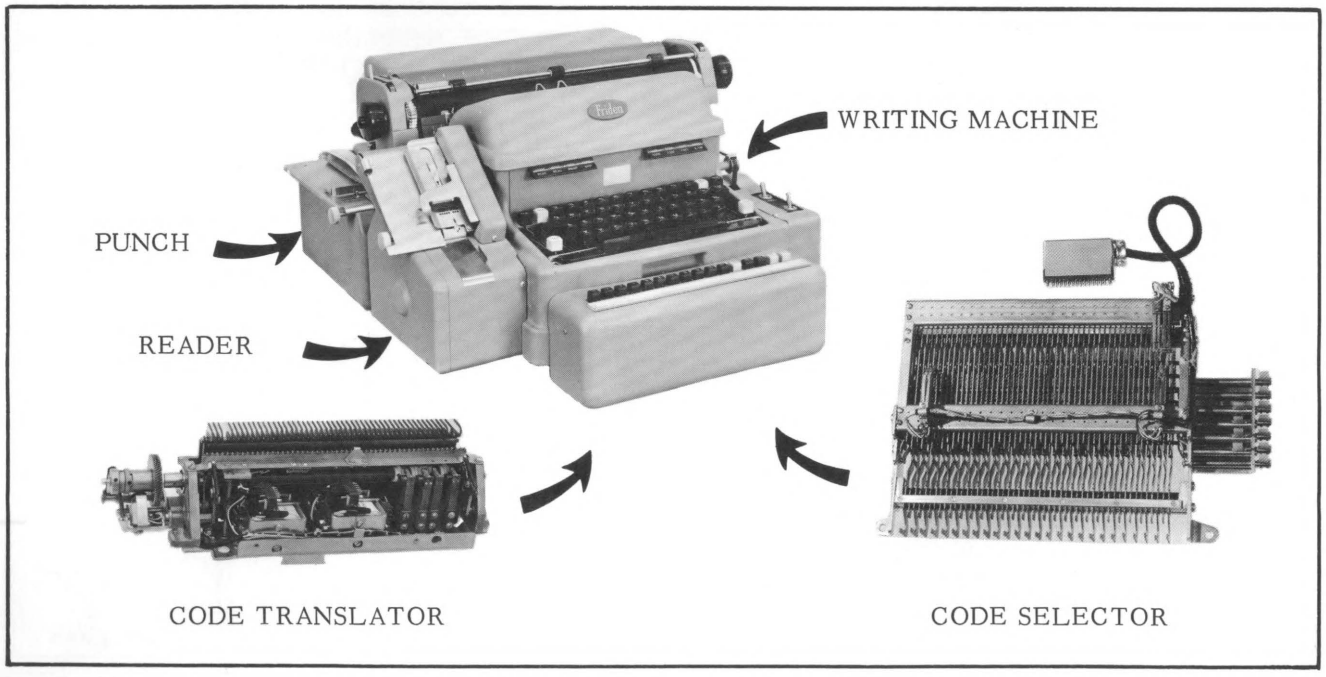


Figure 2. Flexowriter, Model 6011, Components.

Figure 3. Flexowriter, Model 6011, Keyboard - Single Case.

Writing Machine. Contains the keylevers and all other necessary equipment to allow the Flexowriter to write a document.

Code Selector. When a keylever on the writing machine is operated, either manually or by action of the code translator (automatically), the code selector converts this mechanical action into a series of electrical impulses which are sent to the punch. The code selector also transmits impulses directly to the Central Processor of the 6010.

Edge-Card Punch. If the punch is on at the time the impulses are received from the code selector, the code assigned to that keylever which is operated will be punched in the tape or card.

KEYBOARD

Figure 3 shows the fully electric keyboard of the Flexowriter, Model 6011, single case machine. There are four rows of keylevers, and each row is slightly banked for maximum operator speed and ease of operation. Only a 2-1/2 ounce touch and a total keylever movement of 1/4 inch is required to manually operate any keylever. This keyboard is almost identical to the standard typewriter keyboard. Therefore, it will not be explained in this manual. However, it should be pointed out that the operation of any keylever will cause the code corresponding to that keylever to be punched in tape, if the punch has been turned on.

The four white keylevers shown above are non-escaping, non-writing keylevers which are used exclusively for controlling the punch. They are seldom operated manually, but automatically from codes punched in tape or cards. The function of these keylevers is described later in this section under KEYBOARD PUNCH CONTROL.

CARRIAGE

A 16-inch carriage is standard on the Flexowriter, Model 6011, but a 20-inch carriage is optional. The chart below lists the maximum paper size and writing line for each of these carriage lengths. This Flexowriter permits the typing of six lines of copy to the vertical inch.

CARRIAGE LENGTH	MAXIMUM PAPER SIZE	MAXIMUM WRITING LINE
16"	15"	13-1/2"
20"	19"	17-1/2"

PANEL SWITCHES

Above the keyboard of the Flexowriter there are eight panel switches which are manually operated (see figure 4). The function of these switches is explained below:

Touching and releasing the START READ switch initiates the reading action of the Flexowriter. Holding this switch depressed, temporarily stops the reading action until it is released. This gives the operator the ability to pulse one code at a time through the reader. It is especially useful when updating tapes or edge-punched cards.

Touching and releasing the STOP READ switch stops the reading action of the Flexowriter.

Touching the NON PRINT switch causes the reader to be directly connected to the punch and to begin reading. All codes read in the reader will be reproduced in the punch. During this operation, there will be no printing, carriage movement, or other function of the Flexowriter. However, the punch must be on for reproduction to occur.

This function is called a non-print condition to differentiate it from the normal read condition, where printing and machine functions do take place. When the non-print condition is caused by operation of the NON PRINT panel switch, this condition is termed manual non-print.

The manual non-print condition stops upon reading a Stop code, after reproducing that code. It also can be terminated by touching the STOP READ panel switch. Manual non-print is used for reproducing and updating cards and tape.

Touching the TAPE SKIP panel switch causes tape (or cards) to cycle through the reader without causing printing, punching or any other function of the Flexowriter. The skip condition is terminated upon reading the Tape Skip Restore code, or when the STOP READ panel switch is touched. TAPE SKIP is used when data in the tape is to be bypassed under certain conditions, and read under other conditions.

To be operative, the AUX CODE switch must be used in conjunction with a keylever operation. When AUX CODE is held depressed and a keylever operated, the number 3 and 4 code bits are added to the code punched by that keylever. This switch is used to punch control codes which are used in conjunction with auxiliary input and output equipment.

Touching and releasing the STOP CODE switch causes the Stop code (1-2-4) to be punched in the tape. When this code is read, it will stop the reading action. The Stop code is used to make manual entries on the document being typed. It also is normally used to end all punched tapes and cards.

Depression of the TAPE FEED switch causes tape to be fed through the punch and perforated with a 1-2-3-4-5-6-7 code for as long as it is held down. The punch must be on for this action to occur, and this switch will not affect any connected auxiliary equipment.

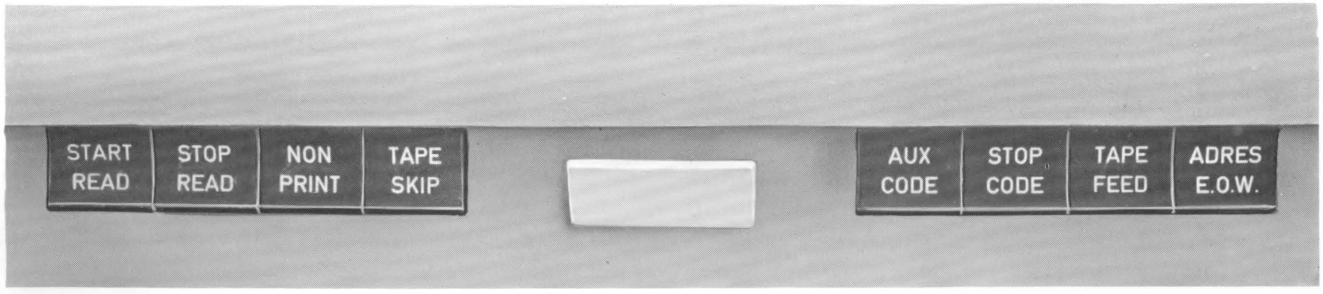


Figure 4. Panel Switches and Indicating Light.

TAPE FEED is also used to delete incorrect codes, punching the Delete code (1 thru 7).

The ADRES-E.O.W. switch performs a dual function. When depressed in conjunction with any keylever, it adds the number 8 code bit to the code punched by the keylever. This allows the punching of Address codes, which are used with a special auxiliary reader, and Program codes for computer use.

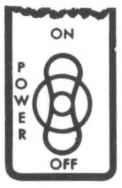
The second function of the ADRES-E.O.W. switch is a computer function. When operated alone, this switch sends and end-of-word signal to the Central Processor to inform it that an entry has been completed. No code is punched in the tape or edge-punched cards during this operation.

INDICATING LIGHT

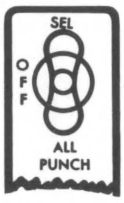
A white indicating light is located in the center of the front panel of the Flexowriter. This light glows when the Flexowriter punch is on.

CONTROL SWITCHES

To the right of the keyboard are two switches which control the power and the punch of the Flexowriter. A brief explanation of these switches follows:



The POWER switch controls the flow of current to the Input-Output unit. This switch must be operated in conjunction with the power switches on the Central Processor in order for the complete system to function as a single unit.



The Punch Control switch is a three-position toggle switch which controls the Flexowriter punch. When in the ALL position, all operations of the keyboard are recorded as codes punched into the tape. These operations can come either from manual operation of the keyboard or automatically from the Flexowriter reader.

When this switch is in the OFF position, the punch cannot be operated. The SELECT position allows the punch to be turned on and off by the punch control keylevers and also automatically by instructions from the Central Processor.

KEYBOARD PUNCH CONTROL

There are four keylevers on the Flexowriter which are not found on a standard typewriter . . . ON 1, ON 2, OFF and FC ON. The first three, shown below, directly control punching from the keyboard. These keylevers will punch their respective codes only when the punch control switch is in the ALL position. When the switch is in the SELECT position, these keylevers will perform their functions, but will not punch codes. They have no function when the punch control switch is in the OFF position.

ON 1 - Turns on the Flexowriter punch when operated and the punch control switch is in the SELECT position.

ON 2 - Turns on the auxiliary output unit if one is connected.

OFF - Turns off both the Flexowriter punch and the auxiliary output unit.

FIELD PUNCH CONTROL

Both the Flexowriter punch and the auxiliary output unit (if one is used) can be turned on and off by the position of the Flexowriter carriage. This is accomplished through the use of the field control rack located immediately behind the carriage.

The field control rack consists of 12 vertically spaced control channels, which are numbered on both the left and right side for ease of identification (see figure 5). Small cams, called actuators, are secured to the control rack in channels 1 thru 4 to control the Flexowriter punch (punch number 1), and auxiliary output unit (punch number 2) by position of the carriage. The following functions have been assigned to control channels 1 thru 4.

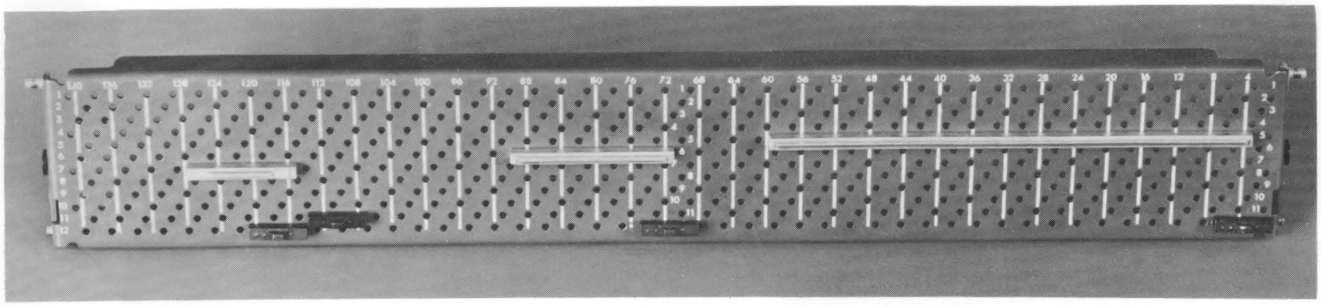


Figure 5. Field Control Rack.

Channel 1 - On 1

Channel 2 - On 2

Channel 3 - Off 1

Channel 4 - Off 2

Note: The remaining eight (5 thru 12) control channels on this rack have to do with the selection of individual computer programs and carriage tabulation control by means of carriage position. These functions will be explained in detail in Section IV of this manual.

As the carriage moves from right-to-left, these actuators come into contact with field switch rollers which are in a fixed position. They operate to turn on and off the Flexowriter punch and the auxiliary output unit, provided the Flexowriter is in a field control condition.

Operation of the FC ON keylever, either manually, or automatically by the Field Control code, places the Flexowriter in a field punch control condition. The field control condition can also be activated directly by a wired computer program instruction.

Note: It is possible to have the Flexowriter under both field punch control and keyboard punch control simultaneously. If the Flexowriter has been previously under field punch control, an Off code (OFF keylever) must precede On 1 and On 2 codes.

READER

The edge-card reader on the Flexowriter, Model 6011, operates at a rate of 572 codes per minute. This is equivalent to approximately 100 five-letter words per minute.

PUNCH

The edge-card punch accepts codes selected by manual keylever operation at a rate of 1,000 codes punched per minute. This is the equivalent of approximately 200 five-letter words. It will accept any two successive keylever operations occuring at the rate of 1,200 per minute.

TAPE USED

A one-inch wide tape (see figure 6) is used on the Flexowriter, and is punched with an eight-unit code. Code hole positions (channels) are numbered 87654321, from left-to-right across the width of the tape. Feed holes assure positive positioning of the tape in the reader and the punch. They are located between the third and fourth code holes, .394 inches from the right (guide) edge of the tape, and are in line with the code holes.

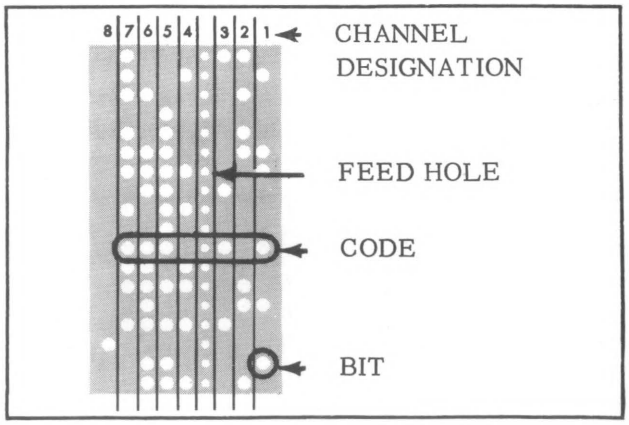


Figure 6. 8-Channel Punched Tape.

CODE SYSTEM

An eight channel Systems Code is used by the Flexowriter, and is referred to as a binary-type code. This simply means that for every code hole position in the tape there are two possibilities, either a hole is punched, or no hole is punched. There are eight punching positions (channels) for each code. And a code is made up of various combinations of punching in these eight channels. This coding system allows for a possible 256 code combinations, and is suited to electrical parity checking methods.

Of the possible combinations, the Friden Flexowriter uses only those codes which have a odd number of bits (code holes). This has permitted the installation of electrical circuitry to check that each code punched meets this condition. Every Flexowriter, Model 6011, is equipped with this "odd-count parity check feature" which provides a positive check against mechanical failure of the punch. A code chart listing all of the codes used by this Flexowriter is found on page 51 of this manual.

CONNECTORS AND RIBBON LEVER

On the right side of the Flexowriter, there are two connectors (see figure 7). These connectors allow auxiliary input-output units to be operated on-line with the Friden 6010 Electronic Computer, thereby increasing its versatility in systems applications. The various input-output equipment available with the 6010 is listed on page 50 of this manual.

A manually-operated three-position switch (see figure 7), called the ribbon position lever, selects between the upper and lower

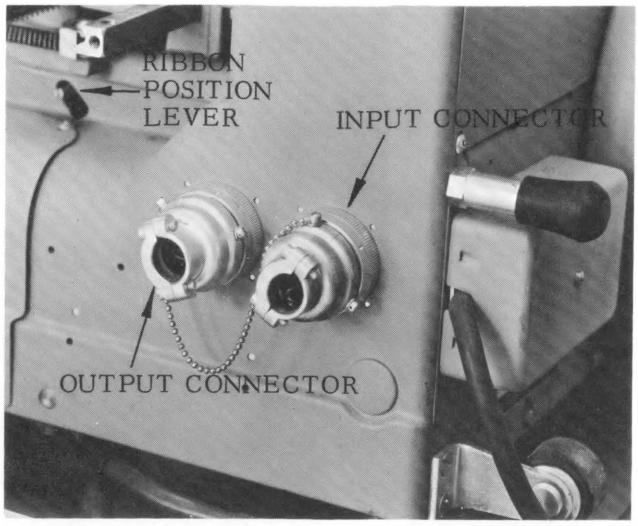


Figure 7. Connectors and Ribbon Lever.

halves of the typing ribbon. The center position disengages the ribbon to allow for stencil and other master preparation, should this ever be required.

PROGRAM KEYS

A row of computer program keys is located directly in front of the Flexowriter, Model 6011, keyboard. These 16 keys (see figure 8) are used for computer program selection and program modification. The following functions have been assigned to these keys:

Manual Program Selection	- 1 thru 11
Tape Program Selection	- 12
Program Selectors	- 13 and 14
Manual Selectors	- 15 and 16

Note: The function of the 6010 program keys will be explained in detail in Section IV of this manual. They are only mentioned at this time to acquaint the reader with their position in regard to the Flexowriter.

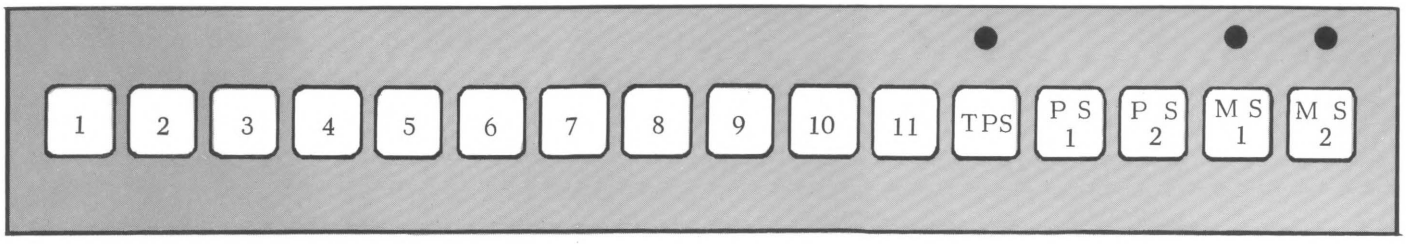


Figure 8. Friden 6010 Electronic Computer - Program Keys.

SECTION III
CENTRAL PROCESSOR

GENERAL

The Central Processor controls and supervises the Friden 6010 Electronic Computer system by providing program control, arithmetic processing, logical operations, and input-output control. Four main components make up the Central Processor: the control unit, logic unit, arithmetic unit and storage unit (see figure 9). In addition, an operation-display panel is located on the top of the processing unit. This section describes in detail the components and features of the Central Processor.

OPERATION-DISPLAY PANEL

The operation-display panel of the Central Processor contains the various operating keys and indicating lights for the 6010. These lights and push buttons enable the operator to control the system and monitor its operation.

Indicator Lights. There are three sets of lights on the operation-display panel. These are identified as: PROGRAM LINES, PROGRAM LEVEL and PROGRAM SELECTOR (see figure 10). The function of each of these indicators is explained below.

PROGRAM LINES - These 26 lights, labeled a thru z, represent the 26 program lines on the 6010. A program line is a series of program steps or levels. There are 242 program steps on the control panel, and these steps are organized into 26 program lines of predetermined lengths, varying from 3 steps to 15 steps, as shown below.

PROGRAM LINES	NUMBER OF STEPS
A, B, C, D, E, F	15 Steps Each
G, H, I, J	12 Steps Each
K, L, M, N	10 Steps Each
O, P, Q, R	8 Steps Each
S, T, U, V	5 Steps Each
W, X, Y, Z	3 Steps Each

As soon as a program line has been selected, the indicator light corresponding to that line will turn off, indicating the selected program line. This light will remain off until all of the steps or levels programmed in that line have been executed.

PROGRAM LEVEL - These 15 lights represent the steps or levels in a program line, 15 being the maximum number of steps in the longest program lines. A program step or level is a hub on the program panel which can be wired to perform a function (add,

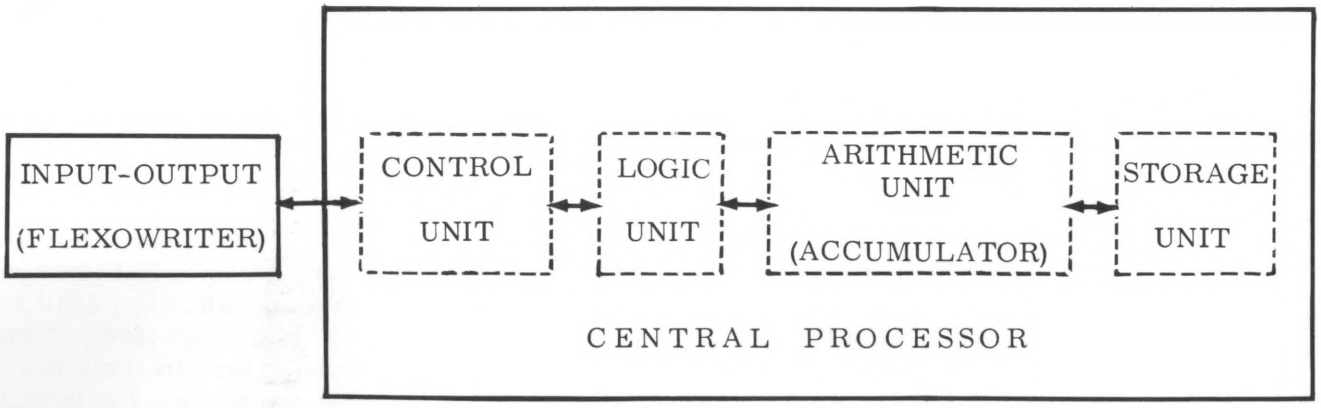


Figure 9. Friden 6010 Electronic Computer System - Block Diagram.

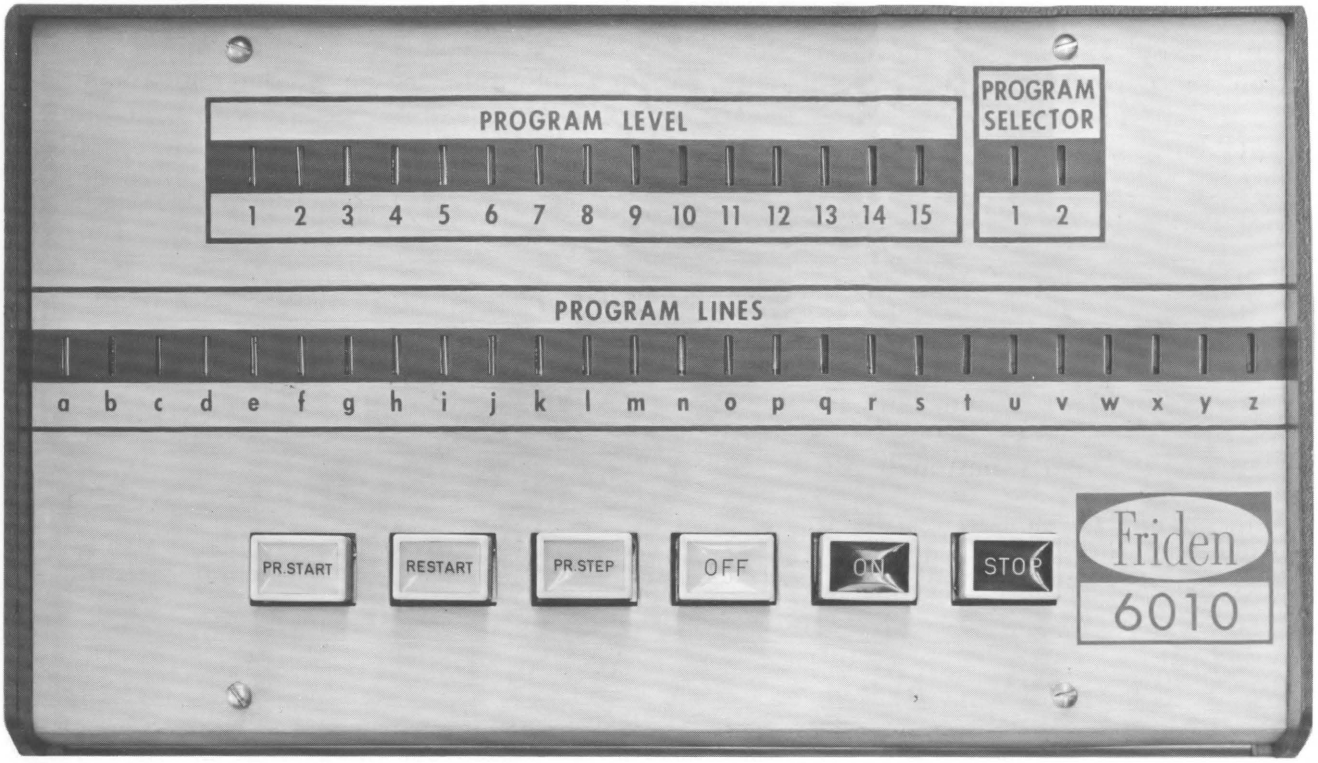


Figure 10. 6010 Computer Operation - Display Panel.

subtract, etc). When a PROGRAM LEVEL light is out, it indicates that this is the next step in the program line to be executed by the Central Processor.

Note: In order to check a program, the Friden 6010 Electronic Computer can be placed in a "step-by-step" condition. And the above lights will indicate what program line is selected and what step in that line is to be carried out.

PROGRAM SELECTOR - Two indicator lights (numbered I and II) are provided to show the status of program selectors 1 and 2. These selectors are used in logical or other programmed operations. When a selector is in the normal state, the indicator light will be out. When a selector is transferred (energized and operative) the indicator light will glow.

Push Buttons. Immediately below the indicator lights, there are six push buttons (see figure 10). All of these buttons, with the exception of PR. STEP are of the non-latching type. The PR. STEP button will lock when depressed. It can be unlocked by depressing it a second time. All push buttons, except the OFF button, are equipped with an insert light that glows when they operate. The function of each push button on the console is explained below.

ON (Power On) - Depression of this button turns on the power to the Central Processor. When power is on, the green insert light will glow. And it will remain on until the OFF push button is depressed, or power is otherwise turned off. Power switches on both the Flexowriter and the Central Processor must be on in order for the complete system to function as a single unit. However, the power switch on the Flexowriter should be turned on prior to operation of the ON push button located on the console of the Central Processor.

PR. START (Program Start) - This button performs a dual function. When the 6010 is first turned on, depression of this button resets the program selectors to their normal position. During operation, the insert light glows when the Friden 6010 Electronic Computer is in an active program.

If the 6010 has been stopped during a program line by manual depression of the STOP button, the program line may be re-executed from the first step on depression of the PR. START button, providing all elements of the program have been re-positioned to their starting point.

PR. STEP (Program Step) - Depression of this locking-type button places the 6010 in a single-step mode of operation to facilitate program check-out (see RESTART). As long as this button remains depressed, the insert light will glow. A second depression releases the PR. STEP button.

RESTART - Is used in conjunction with the PR. STEP button. When in a single-step mode of operation, each depression of the RESTART push button will step the instruction counter one step. This allows the operator to observe the operation of the 6010 a step-at-a-time.

After the PR. STEP push button is released, the next depression of RESTART will re-establish normal operation.

STOP - Has a dual function. Depressing this push button during operation will cause an immediate stop in the Central Processor. When the red indicating light associated with the STOP push button comes on during processing, this indicates that there has been an invalid transfer of data within the Central Processor. If this condition occurs, the machine must be cleared and the program restarted at the beginning of the operation during which the error occurred.

OFF (Power Off) - When depressed, this push button turns off the power to the Central Processor. However, the power switch on the Flexowriter will have to be turned off independently.

PROGRAM PANEL

All operations of the Friden 6010 Electronic Computer are controlled by wiring on a removable program panel (see figure 11). This panel is located on the front of the Central Processor, and is the source of program instructions to this unit. The use of the program panel provides a quick and flexible means by which the 6010 can be adapted to meet the requirements of various programs. Flexibility is obtained by making electrical pulses available at certain hubs on the program panel and wiring them externally to other hubs. This causes the 6010 to perform functions in the desired sequence.

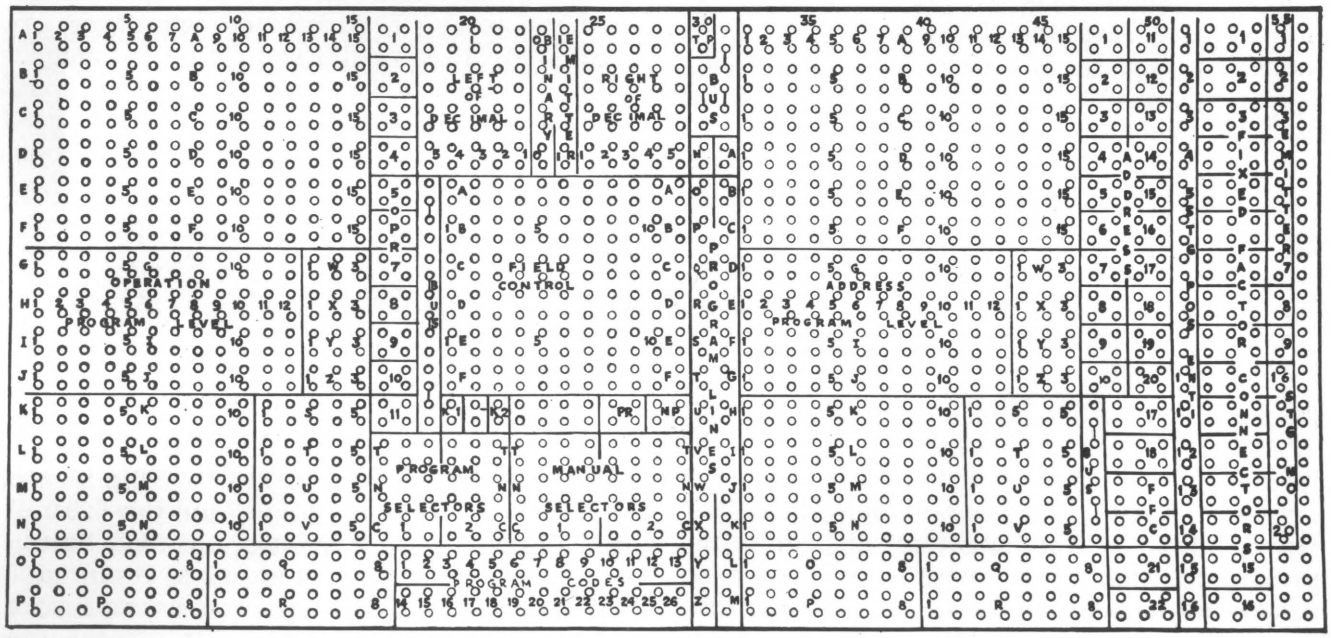


Figure 11. Program Panel Layout.

The program panel on the 6010 contains 896 double hubs and is divided into several sections. A simple programming method has been devised which involves the sequential wiring of this panel. The sections of the program panel and the method of wiring it will be explained in Section VI of this manual.

Interchangeable program panels allow the 6010 to be used in more than one application. In most cases a separate panel will be required for each program. However, changing the panel is a simple procedure and requires only a few seconds.

ARITHMETIC UNIT

The arithmetic unit of the Central Processor performs all of the arithmetical functions for the Friden 6010 Electronic Computer. These functions are performed in the accumulator of this unit and include:

Addition

Subtraction

Multiplication

Storage Access

The accumulator has a capacity of 16 decimal digits. And the decimal is fixed for numerical entry and readout between the sixth and seventh positions, from the right as shown below.

—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Position 16 is used as a sign position in arithmetical operations. For example, a larger number subtracted from a smaller number results in a tens-complement (the complement of the negative answer with preceding high order 9s). Therefore, a 9 appearing in position 16 of the accumulator is recognized as a negative condition during logical operations.

CONTROL UNIT

The control unit of the Central Processor directs and coordinates the functions of the Friden 6010 Electronic Computer system. This unit provides control of processing steps programmed on the control panel; and control of input from and output to the Flexowriter, Model 6011, the accumulator, and the storages.

Readouts and entries of numerical data are via the accumulator, and are controlled as to field length through left and right of decimal patterns. Five different "LRD patterns" are available to the programmer, and these may vary up to 10 digits left of decimal and 5 digits right of decimal.

All readouts from the Central Processor must be controlled by left and right of decimal patterns, and entries may be so controlled at the option of the programmer. Five sets of hubs, known as capacity control hubs, are provided on the program panel for the establishment of left and right of decimal patterns.

STORAGE UNIT

The 6010 has both variable and fixed memory. A total of 20 storage locations are provided: 15 variable and 5 fixed storages. Figure 12 shows a schematic of the Input/Output Flexowriter and the 6010 Central Processor, including all storage locations.

Variable data is stored in magnetic cores. And each storage unit has a capacity of 16 decimal digits. Therefore, all 15 of these storages provide a total capacity of 240 decimal digits. Variable storage locations are used to store totals and serve as working storages for intermediate processing.

More than one group of data may be stored in a single storage by programming. This is known as "splitting" a storage. A common split is 8/8. However, any division of a storage is possible to accomplish the requirements of a particular application.

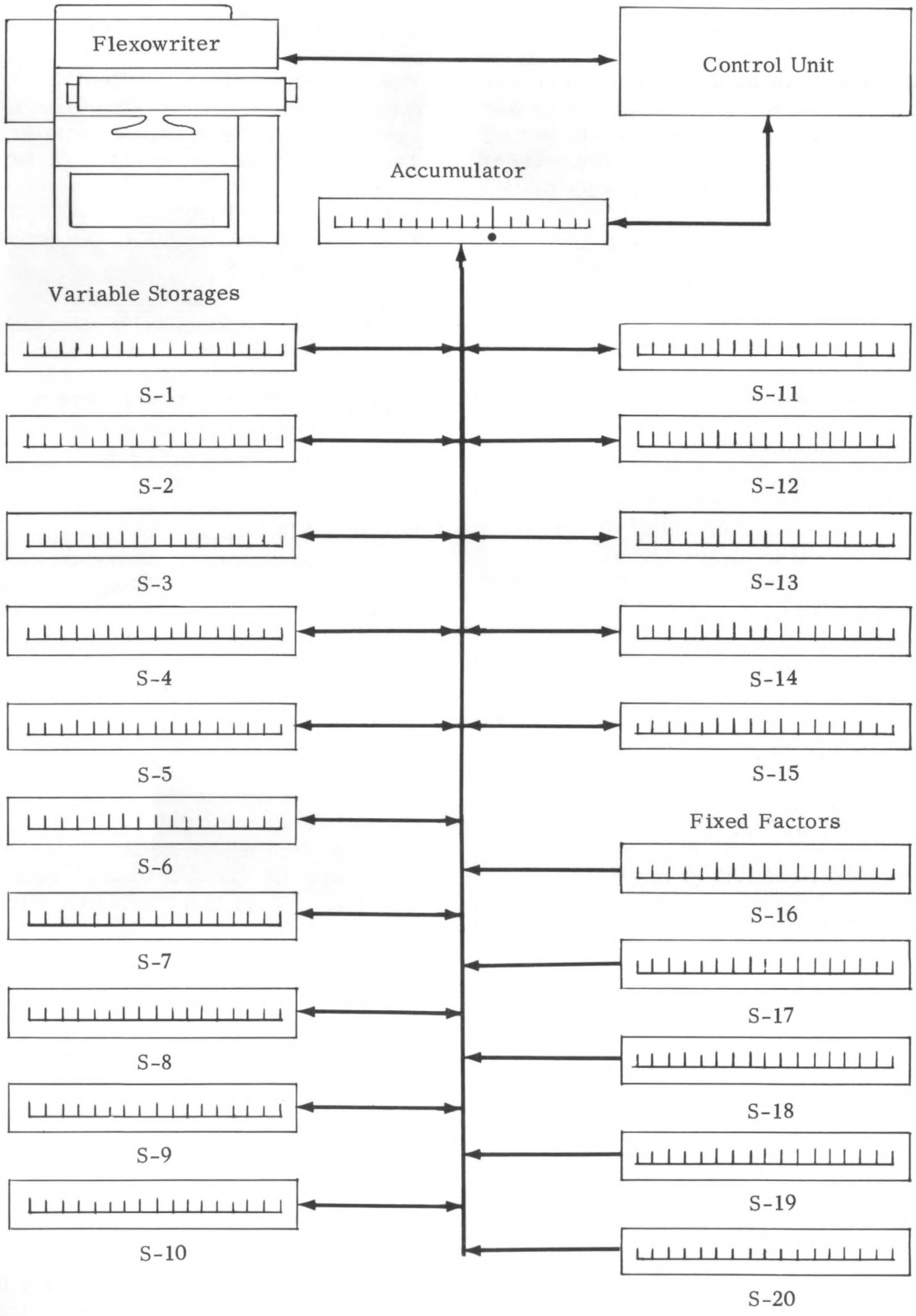


Figure 12. Writing Unit/Central Processor - Flow of Information.

Five fixed factor locations, each with a capacity of 16 decimal digits, provide fixed numeric data input under program control. Fixed rates, taxes, and other factors required for computation are available by means of program panel wiring. These factors may be varied for each application on the 6010.

As previously stated, the Friden 6010 Electronic Computer utilizes magnetic core memory for storing data. The design of this type of memory unit makes each storage individually addressable and instantly available for computer processing.

Basically, a magnetic core is a very tiny ring of ferromagnetic materials, only a few hundredths of an inch in diameter. Its compact size is a decided advantage in computer design because the entire core storage takes up very little space in the Central Processor. An example of the magnetic core storage that is used in the 6010 is shown in figure 13.

Hundreds of these small rings are combined to make up the memory unit of the 6010. Several wires pass through each ring. By sending impulses through these wires, a core becomes magnetized and can be used to represent a 0 or 1. For computer purposes this is the basis of the binary coded decimal system of storing data.

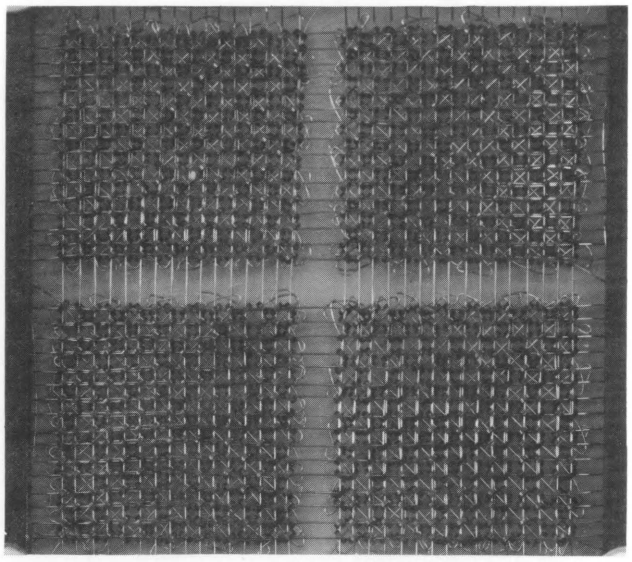


Figure 13. Core Storage of 6010.

LOGIC UNIT

The logic unit can be thought of as the decision making center of the Central Processor. It gives the Friden 6010 Electronic Computer the ability to choose between alternate programs and thereby perform logical operations. These include making program selections, performing iterative operations within a program line, or making a jump from one program line to another. Logical operations in the Friden 6010 Computer are based on testing the accumulator for a value which may be greater than or equal to zero ($A \geqq O$), or less than zero ($A < O$).

SECTION IV
OPERATING PRINCIPLES

GENERAL

This section describes the principles of operation of the Friden 6010 Electronic Computer system. It includes a description of the 6010's ability to control the input-output unit, and defines the operation of both the storages and the accumulator. In addition, this section explains the methods of entering data into the Friden 6010 Electronic Computer, and the methods of selecting 6010 program lines.

FLEXOWRITER CONTROL

The Central Processor of the 6010 coordinates the operation of the Flexowriter, Model 6011, automatic writing machine, with the computing operation of the electronic unit. More over, the Central Processor also contains facilities to automatically control any function of which the Flexowriter is capable. These functions include: automatic writing, selective punching of by-product tapes in the Flexowriter punch and auxiliary punch; starting and stopping of the integral Flexowriter reader or a cable connected reader; initiating non-print, tape skip and skip tab; and, in general, any other operations that might otherwise be left to manual operator control.

Ability to select these functions by instructions wired into the program panel of the Central Processor, provides the programmer with outstanding flexibility in all types of applications. In addition, the placement of these functions under automatic program control can: eliminate operator decisions; provide more precise control with regard to the selection of data and functional codes transmitted to tape punches or other auxiliary equipment; and markedly increase the efficiency of the data processing system.

Functions which the Flexowriter is capable of performing have been explained in Section II of this manual. Therefore, they will not be repeated here. However, the ability of the 6010 to control input equipment is of particular importance and will be described in detail in this section.

INPUT CONTROL

The Central Processor functions as the command center of the 6010. It can exercise complete control over all input into the Friden 6010 Electronic Computer system. This includes initiating reading action, interrupting it, or stopping it completely.

The Central Processor is activated by a program code sensed in a reading unit, or by carriage position control. (Both of these methods of activation will be explained in detail later in this section.) When activated, the Central Processor immediately assumes control of all input units, and begins to execute a series of instructions in a selected program line. Reading action of the Flexowriter or any input unit is interrupted when the Central Processor executes an instruction. But the reading action will begin again either on command from the Central Processor, or will be automatically resumed at the termination of the selected program line. However, since instructions are executed at electronic speeds, there is no apparent delay in the reading action.

FACTOR A QUANTITY	FACTOR B PRICE	DESCRIPTION	NET AMOUNT
10.	10.00U	NET EXTENSION	100.00

To illustrate the principles that have been explained, consider the above net extension, and assume that the Central Processor is activated by a program code read at the beginning of the line. Reading action will be suspended while the Central Processor executes any preparatory instructions prior

to accepting the quantity factor. Quantity is typed and the Processor commands the Flexowriter to tabulate to the price field and read-in the price from the tape. The operation of the reader is once again momentarily interrupted as the Central Processor continues to execute the remaining instructions (including multiplying quantity X price) in the program line.

When this program line has been completed, the reader automatically starts again and prints the description. By reading a second program code in the tape, it is now possible to reactivate the Central Processor to select a new program line. As soon as the Processor again begins to execute the instructions in this line, the reading action will halt. The Central Processor will then command the Flexowriter to print the net extension and carriage return. Any remaining instructions in the program line will be executed, and the reader will become active again.

The Central Processor can command, by instruction, either the Flexowriter reader or the auxiliary reader to operate. This permits switching of reader action during a program. Data, therefore, can be called for by the electronic unit from three sources: the keyboard, the Flexowriter reader and from an auxiliary reader, if one is connected to the system. In addition, the Central Processor can condition either reader to be on at the end of a program line, thereby providing automatic reader operation with no manual effort required.

The Central Processor can condition either reader to operate and cause printing by the input-output unit, or can by-pass the input-output printer. This latter condition is known as non-print. By means of the non-print condition, digital data contained in tape or cards can be entered directly into the Central Processor without causing printing by the Flexowriter. And, in the same manner, digital data contained in the Central Processor can be punched directly into tape without causing printing by the Flexowriter, Model 6011.

All program codes are recognized during the non-print condition. This allows the Central Processor to select program lines and execute the instructions contained in these lines during this condition. Also, when in non-print, it is possible to switch reading action between two readers by 6010 commands; thereby providing the Friden 6010 Electronic Computer with exceptional flexibility. For example, during the non-print condition it is possible to enter data into the Central Processor from two different sources and perform arithmetic functions utilizing this data. If desired, the results of these calculations could later be punched into tape with no printing by the Flexowriter. Or the results of the calculations could be both printed on the document and punched in tape.

STORAGE OPERATION

The Friden 6010 Electronic Computer has both variable and fixed storage locations. Each storage has a capacity of 16 digits. The operating features of these storages are explained below:

Variable Storage. There are 15 variable storages identified by the numbers 1 thru 15. Variable storages are used as working storages, and to store accumulative totals. These storages can only be used to accept and store amounts. They cannot add, subtract, multiply or perform any other arithmetic operation.

Variable storages may be "split" to increase the number of totals to be stored. This splitting is a division of a storage into two or more parts. A common split of a 16-digit variable storage is 8/8. However, a storage may be divided into any number of parts, depending upon the requirements of the particular application.

Entry into variable storage is destructive. Whenever a new entry is transmitted into a variable storage, the previous contents are erased. Variable storage readout is non-destructive. At any time, the amount stored in a variable storage can be read out, and will still be retained in storage. To clear a

variable storage completely, zeros must be entered into it from the accumulator.

Fixed Storage. There are 5 fixed storages identified by the numbers 16 thru 20. These storages can transmit their contents to the accumulator by addition, subtraction and multiplication. Fixed storages cannot accept entries. Entries are recorded in them only through program panel wiring.

Fixed numeric data can be wired into these storages to provide access to constant factors used in the program. Some typical uses of these constant factors are in rounding, indicating fixed upper and lower limits, fixed rates and the incrementing of consecutive numbers.

ACCUMULATOR OPERATION

The accumulator has a capacity of sixteen digits. A fixed decimal is located between the sixth and seventh digit position from the right for entry and readout only.

All entries into the system from the Flexowriter or auxiliary equipment, internal transfers to or from the variable storages and readouts to the Flexowriter or auxiliary equipment are made via the accumulator.

For example, if it is desired to enter a number from the Flexowriter into variable storage S-1, this number is first entered into the accumulator and then transferred to storage S-1. If it is desired to transfer a number from one variable storage to another, the number is transmitted from the first storage to the accumulator, and then transferred from the accumulator to the second storage. The same holds true in reading out a number from storage; the number is transferred to the accumulator and then to the Flexowriter.

Entries from the Flexowriter to the accumulator are received serially, and enter the accumulator from right to left. Assuming the accumulator is clear prior to entry, and the number 123456 is entered from the Flexowriter, the accumulator would operate as follows. As each digit is entered, those already in the accumulator shift one position to the left. The successive entry of each digit is shown step-by-step in figure 14.

It should be noted that the shifting of the accumulator prevents the direct addition of two consecutive entries from the Flexowriter. The first number entered must normally be transferred to a storage location before the second number can be entered.

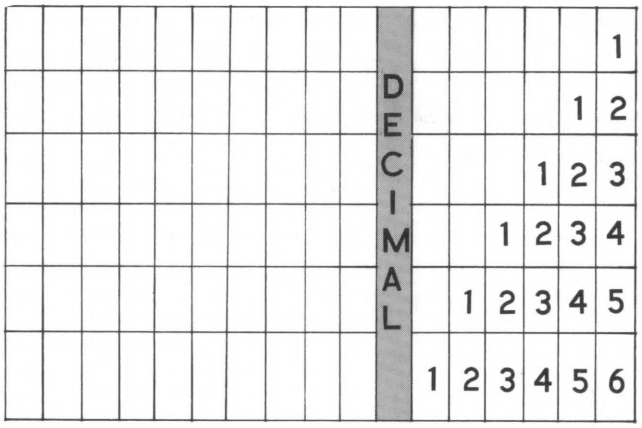


Figure 14. Method of Accumulator Entry.

All arithmetical operations are performed in the accumulator and all answers develop here. This includes: addition, subtraction and multiplication. In order to perform these operations, one factor must always be the contents of the accumulator, and the other factor must be the contents of either a variable or fixed storage location.

In these arithmetical operations the factor stored in the accumulator is replaced by the resultant sum, difference, or product. The factor in storage remains unchanged, therefore it may be used in subsequent operations.

In the accumulator, amounts can be shifted one or more decimal positions either to the right or to the left of the fixed decimal. Mathematically, shifting to the left corresponds to multiplying the contents of the accumulator by a given power of 10; and shifting to the right by a negative power of 10, 100, 1000 . . . etc. Therefore, shifting is used to multiply or divide the amount in the accumulator by tens, hundreds, etc.

Shifting also is used to eliminate unnecessary decimal positions. For example, an amount like .1244 could produce an erroneous answer if multiplied by another factor. This is so because the last two digits have no significant value. Therefore, the amount would be shifted four places to the right to eliminate the 44 and the resultant amount would be .12. Also, shifting is used to clear the accumulator. In the clear operation, a 16-position shift to the left shifts all data out of the accumulator thereby clearing it.

Once a total, difference, product, or the result of any kind of operation is available in the accumulator, it can be sent to the Flexowriter, transferred to storage or left in the accumulator for immediate further use. Accumulator readout is non-destructive, and therefore retains the data for subsequent processing.

METHODS OF ACCUMULATOR ENTRY

Entry from the Friden Flexowriter, Model 6011, into the accumulator of the Central Processor can be accomplished from the keyboard or by reading the data from punched paper tape, edge-punched or tab cards. When an auxiliary reader is employed in the system, entries may be made from either reader.

Two basic modes of entry are employed: left and right of decimal (LRD) and end-of-word (E.O.W.) control. These modes may be associated with either manual or reader entry. Normally, the accumulator is cleared prior to making an entry under left and right of decimal control. It is mandatory that the accumulator be cleared prior to making an end-of-word entry.

LRD Control. Left and right of decimal control assumes that an entry will have a fixed length. "Fixed" means that an entry will always have the same number of digits left and right of decimal as one of the five left and right of decimal patterns that have been assigned by the programmer. It should be remembered that these five patterns are established by wiring in the program panel of the Central Processor. And that they may vary up to a maximum of 10 digits left of decimal and five digits right of decimal. Since the 6010 is wired under LRD control to recognize the number of digits left and right of decimal, an entry will automatically be positioned correctly around the fixed decimal in the accumulator. Also, when making an entry under LRD control, automatic decimal printing on a document may be wired into the program panel.

E.O.W. Control. End-of-word control of an entry allows a variable length entry of numeric data into the accumulator from the keyboard or reader of the Flexowriter, Model 6011. "Variable" means that these entries need not conform to the left and right of decimal patterns that have been established. When a variable length entry is made, it is necessary to keyboard the decimal to position the entry properly in accumulator if decimal numbers are a part of the entry. Whole numbers do not require the keyboarding of the decimal.

With end-of-word control, it is not necessary for the operator to space through insignificant digit positions on a document, and to align an entry around a fixed decimal position. This means that data can be entered in any position within a field on the document, and the 6010 will automatically position the entry correctly in the accumulator.

After every variable length entry, it is necessary to send an end-of-word (E.O.W.) signal to the Central Processor to indicate that the entry is completed, and that the electronic unit can further proceed with its operation. There are three methods of indicating E.O.W. to the Processor. These are: from manual or automatic operation of specific keys on the Flexowriter keyboard, depression of a panel switch on the Flexowriter, and reading of the Form Feed code in punched tape or cards. Each of these methods is explained below.

Manual or automatic keyboarding of the tab, carriage return, space, slash, or percent keys will send the end-of-word signal to the electronic unit. However, when using tab, carriage return or space keys, this

command is only effective after the first significant digit (including zeros) has been entered in the accumulator. Also, it must be remembered that depression of any of the above keys will cause carriage escapement; some will cause printing; and all will punch their respective codes in tape if the punch in on.

Depression of the ADRES-E.O.W. panel switch on the Flexowriter will also transmit the end-of-word signal to the Central Processor. Since this panel switch does not cause printing, punching or carriage escapement, it can be used to enter variable length amounts when the punch is on. Furthermore, the ADRES-E.O.W. panel switch is effective regardless of whether or not a significant digit has been entered in the accumulator. This is of particular importance in writing areas which do not always require an entry. In these areas, when there is no entry, depression of ADRES-E.O.W. will signal the Processor that the entry has been completed; the Processor will accept this command without a significant digit having been entered in the accumulator, and no printing or carriage escapement will occur.

The Friden 6010 Electronic Computer has been internally wired to also accept the Form Feed code (1-2-3-4-7) as an end-of-word command. This code is non-escaping and non-reproducing. It also is particularly suitable to follow variable length entries where punching of the end-of-word code is not required in the output tape or cards.

ERROR CORRECTION

A simple procedure, involving the use of the BACK SPACE key on the Flexowriter is provided to correct erroneously keyboarded entries into the accumulator. This key will punch a Tape Feed code (1-2-3-4-5-6-7) when depressed. Depression of the BACK SPACE key will also erase the last digit entered in the accumulator. The key can be depressed several times whenever several wrong digits are to be corrected. The correction procedure is quite simple. If the last digit keyboarded was incorrect, the operator backs the tape one position in order to bring the wrong code over the punch dies, and depresses the BACK SPACE key once. The incorrect digit will be erased in the accumulator and the incorrect code deleted in the tape. If more than one digit were incorrect, the above procedure would be expanded to allow for correcting the number of erroneous digits.

Note: In a variable length keyboarded entry, the BACK SPACE key can be used to correct erroneous entries in any decimal position as long as the end-of-word command has not been given. In fixed length keyboarded entries, however, the last digit left of decimal and the last (least significant) digit of the amount cannot be corrected by the above procedure.

ACCUMULATOR READOUT

Although the capacity of the accumulator is 16 digits, the maximum readout capacity obtainable in one operation is 10 digits left of decimal, and 5 digits right of decimal. All readouts are controlled by the five - left and right of decimal patterns which are assigned by the programmer. Readouts must pass from the accumulator to the Flexowriter, governed by the LRD patterns, and can occur in no other manner. Therefore, it is essential that the LRD patterns be wired to allow for any readout that is required in an application.

During a readout from the accumulator to the Flexowriter, the insignificant zeros (zeros left of the first significant digit) are automatically converted to spaces. If the input-output unit is a double case Flexowriter, the Central Processor will automatically place the Flexowriter in the proper case shift condition to allow the printing of digits.

Note: It should be remembered that LRD patterns are used to control the capacity of entries as well as readouts. But since readout length cannot be controlled by any other means, it is essential when setting up an application to first consider the various readout lengths needed, then the entry lengths. Whether the fixed capacity entry or the variable capacity entry procedure will

be used, will then depend upon the number of LRD patterns still unassigned.

INSTRUCTIONS

The Friden 6010 Electronic Computer performs its functions by executing a series of instructions at high speed. Each instruction contains an operation and an address.

Operations indicate the processing requirements called for by the program. And addresses indicate a particular storage location to be affected, or a particular function to be performed, depending upon the operation with which it is paired. Operations and addresses are expressed by numerical values. These, as well as all 6010 instructions, will be discussed in Section V of this manual.

All of the instructions required to complete a given program, are divided by the programmer into subroutines and assigned to specific program lines. There are 26 program lines available on the 6010, and each line contains a pre-determined number of steps. These program lines have been specifically designed to allow for maximum flexibility in establishing subroutines. And all the instructions necessary to complete a given program can be logically distributed over the 26 program lines. This provides optimum utilization of the Friden 6010 Electronic Computer capacity.

The number of instructions in any program line can be equal to, or less than the number of steps in that line. For example, a 15-step program line may contain 15 instructions, or any number less than 15, such as 14, 13 . . . 10, etc. Program lines are assigned by the programmer, and are established by wiring the program panel.

PROGRAM LINE SELECTION

Program lines can be selected in two ways: by a program code read in tape or cards, or by an actuator on the field control rack combined with depression of program keys 1 thru 11 (see figure 15). Each of these methods of selecting a program line is described below.

Code Control. In the Friden 6010 Electronic Computer system, there are 26 program codes. Reading of a program code in tape or cards sends an impulse to an individual hub on the program panel in the Central Processor. These hubs can be arbitrarily wired by the programmer to select any of the 26 possible program lines.

Program codes consist of bit configurations in channels 1, 2, 3, 4, 5 and 6, combined with a bit in channel 8 (see figure 18). Although a 5th bit is contained in these codes, it has no effect on the 6010.

Program codes are produced by overpunching, in conjunction with depression of the ADRES-E.O.W. panel switch. Figure 18 shows the punching combinations required to produce the 26 program codes. Program codes are reproduced under non-print condition. However, they will always be recognized by the Central Processor, even when read between Non-Print and Print Restore codes.

In order for the Central Processor to recognize a program code, the TPS (tape program selection) key (see figure 16) must be depressed, or the 6010 must be conditioned by programming. Depression of the TPS key places the 6010 Electronic Computer under control of program codes read in tape or cards. As soon as a program code is read, the Central Processor stops the reader immediately, selects the corresponding program line, and begins to execute the instructions in that line.

Actuator Control. The position of actuators on the field control rack, in conjunction with depression of program keys 1 thru 11, can also be used to manually select program lines. Six channels on the field control rack (5 thru 10) are used for 6010 program selection (see figure 17). The assignment of these channels is as follows:

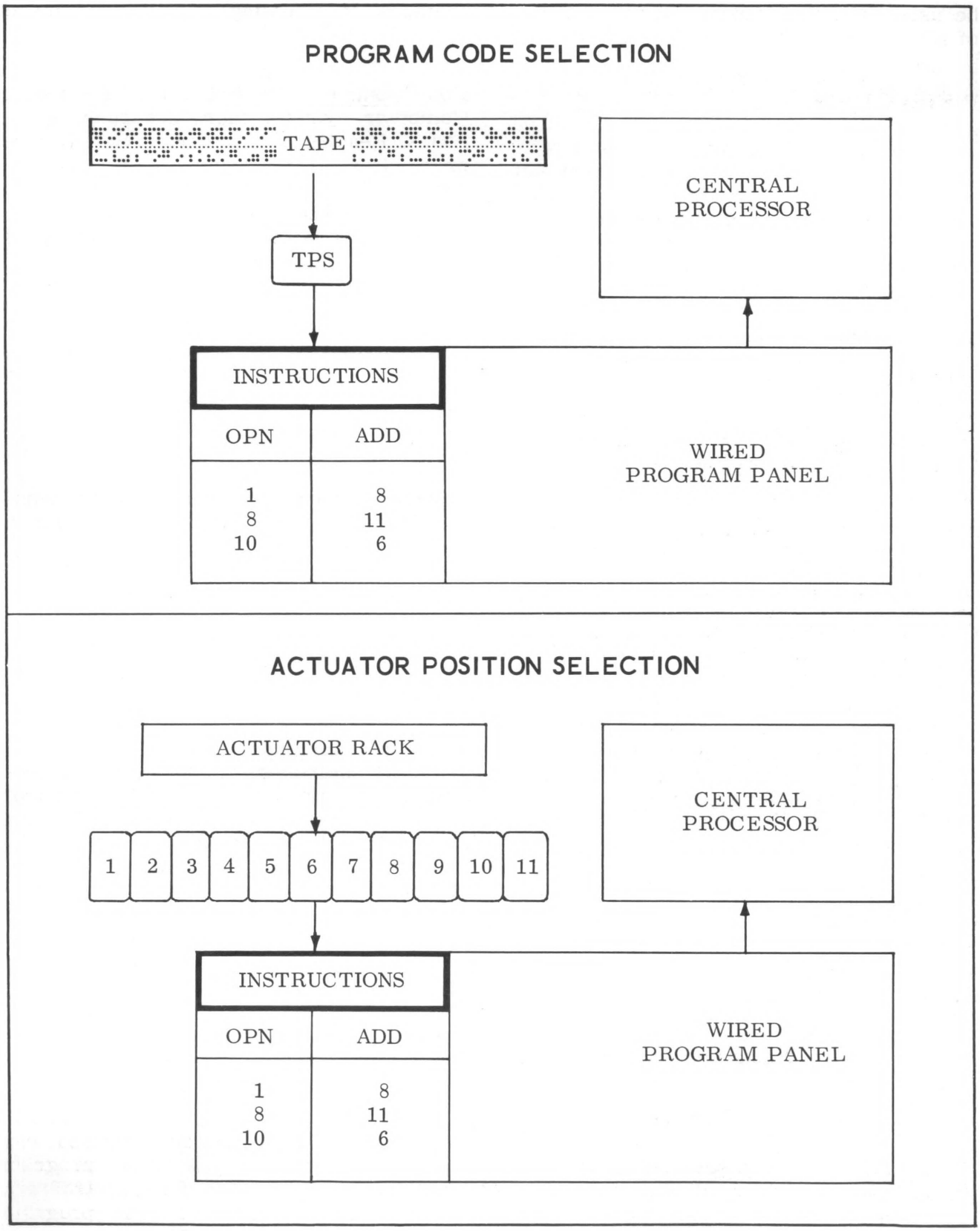


Figure 15. Methods of Program Line Selection.

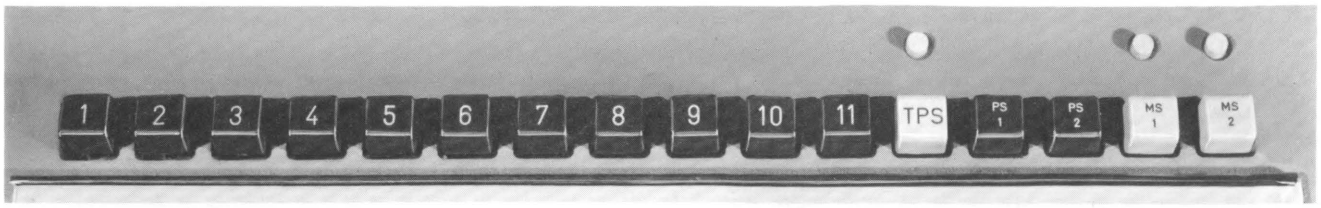


Figure 16. 6010 Program Keys.

Channel 5 - Field Control A
Channel 6 - Field Control B
Channel 7 - Field Control C
Channel 8 - Field Control D
Channel 9 - Field Control E
Channel 10 - Field Control F

Note: The above alphabetic channel designations refer to the markings on the program panel. Channel 11 on the field control rack is used for placement of a skip tab restore actuator. And channel 12 is used for placement of program start actuators.

Actuators of various length can be attached to the field control rack in channels 5 thru 10. The function of an actuator is to hold the 6010 in a selected program line so that it can complete the required number of instructions. Should the Flexowriter carriage move off of the actuator, the program line is immediately terminated. Therefore, the length of any actuator is determined by the number of carriage positions to be traversed during the execution of all the instructions in its corresponding program line.

The leading high point of the actuator in channels 5 thru 10, combined with a two position actuator in channel 12, determines the position on the form in which the program line becomes active. Actuators in channel 12 are known as "program start actuators." Each of the actuators in channels 5 thru 10 must have a 12 actuator to correspond with its leading edge.

In order for the Central Processor to select a program line by means of the position of actuators on the field control rack, one of the program keys, numbered 1 thru 11 must be depressed. These 11 keys and the TPS key are part of a single interlocking system. When one key is depressed, it will lock in that position. Depression of the small white button to the rear of the TPS key automatically releases the depressed key.

When the TPS (Tape Program Selection) key is depressed, the Friden 6010 Computer is controlled by program codes read from tape or cards; and the actuators on the field control rack are inactive. If one of the first 11 program keys is depressed, the program codes which might be read from tape are of no significance to the 6010. Program line selection is no longer controlled by codes, but by the combined action of the program key depression and field actuators. The small white button, located immediately behind the TPS key, will reset all of these 12 program keys to their normal (raised) position.

When a programmer has decided to select one or more program lines by means of actuator positioning, these program lines

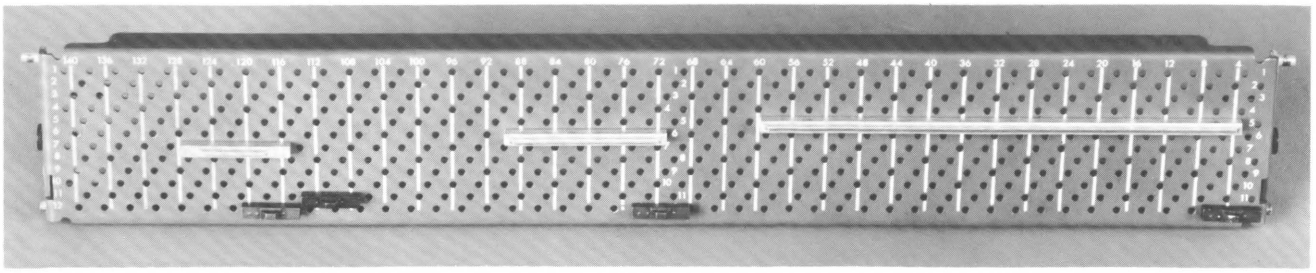


Figure 17. Friden 6010 Electronic Computer - Field Control Rack.

can be arbitrarily assigned to any of the 11 program keys. The allocation of the specific program lines to these keys is established by means of program panel wiring.

It should be noted that the use of either method of program line selection does not prohibit the use of the other method. Both methods of program line selection can be, and in most cases will be, used in the same application. For example, in an invoicing application, the operations necessary to process the item extensions could be selected by program codes in the item cards, but the totalling operation could be entirely program key and actuator controlled.

Since each of the 6 actuator channels (5 thru 10) can be combined with each of the 11 program keys, 66 selection combinations are available. These plus the 26 program codes provide unlimited flexibility for program line selection in any application.

DROPPING A PROGRAM LINE

Once a program line has been selected, it can be dropped in any of the following ways:

1. Completing a line by executing all of the instruction in that line.

2. Moving off of a program actuator.

3. Restoring a program key to its normal position by depression of the white button behind the TPS key.

4. Switching from actuator control to tape control by a Central Processor instruction.

5. Transferring of a selector, either manually (by depression of manual selector keys) or automatically, by programming.

SELECTORS

The Friden 6010 Electronic Computer is equipped with four independently controlled selectors. A selector is a switching device which provides both a normal and an alternate path for an electrical impulse to follow. These two states or conditions are known as "normal and transferred." The point at which a selector is energized, transfers the impulse to the alternate path. In the 6010, selectors provide a means of indicating to the Central Processor that an alternate program line is to be used, and also provide a means of modifying a program during operation.

Selectors may be either manually transferred by special program key depression, or by instructions wired in the program panel of the Central Processor. Each of these methods is explained below.

Manual Control. Two of the four selectors are manually controlled by the MS 1 (manual selector 1) and MS 2 (manual selector 2) program keys on the input-output unit (see figure 16). When depressed, these keys lock in operated position, and cause immediate transfer of the corresponding selector. The selector will remain transferred until the program key is restored. This occurs automatically whenever there is carriage return operation. Manual release can be accomplished by depression of the small release buttons above each program key.

PS 1 (program selector 1) and PS 2 (program selector 2) program keys provide manual control of the two remaining selectors. These keys, located on the program key bank, are of the non-locking type (see figure 16). When either key is depressed, the appropriate selector is immediately transferred if the 6010 is not in program. If the 6010 is in program, selector transfer is delayed until the end of the program line. In either case, the selector remains transferred until restored to normal condition by wired program instruction, or manual operation of the PR. START push button. Manual control of selectors provides the means of modifying program instructions at the discretion of the operator.

Program Control. Normally, the PS 1 and PS 2 selectors are transferred as well as restored to normal condition automatically by 6010 instructions. Transfer of these

selectors may be conditional or unconditional. Conditional transfers in the 6010 system are based on scanning the accumulator for a value which may be greater than or equal to zero ($A \geqq O$), or less than zero ($A < O$). If either of these conditions occur, the selector may be caused to transfer automatically. Program selectors (PS 1 and PS 2) provide the means of automatically making alternate program line selections, performing operation or address modifications and jumping from one program line to another.

FRIDEN 6010 COMPUTER FUNCTIONAL CODE CHART

6010 FUNCTION	TAPE CHANNELS 8	7	6	5	4	FEED	3	2	1	6011 FLEXOWRITER
PROGRAM CODES										
1	8			5		.			1	SP + 1
2	8			5		.		2		SP + 2
3	8					.		2	1	1 + 2
4	8			5		.	3			SP + 4
5	8					.	3		1	1 + 4
6	8					.	3	2		2 + 4
7	8			5		.	3	2	1	3 + 4
8	8			5	4	.				SP + 8
9	8				4	.			1	1 + 8
10	8				4	.		2		2 + 8
11	8			5	4	.		2	1	3 + 8
12	8				4	.	3			4 + 8
13	8			5	4	.	3		1	5 + 8
14	8			5	4	.	3	2		6 + 8
15	8				4	.	3	2	1	7 + 8
16	8		6	5		.				SP + 0
17	8		6			.			1	1 + 0
18	8		6			.		2		2 + 0
19	8		6	5		.		2	1	3 + 0
20	8		6			.	3			4 + 0
21	8		6	5		.	3		1	5 + 0
22	8		6	5		.	3	2		6 + 0
23	8		6			.	3	2	1	7 + 0
24	8		6		4	.				8 + 0
25	8		6	5	4	.			1	Y + 1
26	8		6	5	4	.		2		Y + 2
END OF WORD										ADRES/E.O.W. (PANEL)
E.O.W.		7			4	.	3	2	1	FORM FEED (AUX L)
E.O.W.	8					.				CARRIAGE RETURN *
E.O.W.			6	5	4	.	3	2		TAB *
E.O.W.				5		.				SPACE (LOW ORDER)*
E.O.W.			6	5		.			1	/
E.O.W.		7		5	4	.		2	1	%
DECIMAL		7	6	5	4	.		2	1	.
DIGIT 1						.			1	1
DIGIT 2						.		2		2
DIGIT 3				5		.		2	1	3
DIGIT 4						.	3			4
DIGIT 5				5		.	3		1	5
DIGIT 6				5		.	3	2		6
DIGIT 7						.	3	2	1	7
DIGIT 8					4	.				8
DIGIT 9				5	4	.			1	9
DIGIT 0			6			.				0
DIGIT 0				5		.				SPACE (HIGH ORDER)

+ ADRES E.O.W.

*Operates only after entry of significant digit (zero thru 9).

Figure 18. 6010 Functional Code Chart.

SECTION V
PROGRAM INSTRUCTIONS

GENERAL

The Friden 6010 Electronic Computer is directed to perform each of its functions by an instruction wired into the program panel. This section describes all of the instructions that are used in the Friden 6010 Computer system. A simple example of a routine incorporating these instructions is both explained and illustrated. In addition, this section describes the rules to follow when programming any 6010 application.

SUMMARY OF INSTRUCTIONS

It should be remembered that instructions are expressed in two parts: the operation and the address. Operations indicate the function to be performed: arithmetical, shift, store, input-output, or logical operations. An address indicates the location of the operand (when associated with an arithmetical function), the number of positions to be shifted, the type of input-output, or logical function to be performed. A summary of all 6010 instructions follows.

Arithmetical Instructions. These are the instructions by which the Central Processor is conditioned to carry out the arithmetical functions of addition, subtraction and multiplication. There are three arithmetical instructions.

1/n - Add storage n (any storage 1 thru 20) to the contents of the accumulator. The sum of this operation will develop in the accumulator.

2/n - Subtract storage n (any storage 1 thru 20) from the contents of the accumulator. The difference will develop in the accumulator.

3/n - Multiply storage n (any storage 1 thru 20) by the contents of the accumulator. The result of this multiplication will develop in the accumulator.

Note: It should be remembered that a transmission of data from storage does not erase the contents of the storage. Therefore, even though data is transmitted from storage to the accumulator in the above instructions, it still remains in storage.

Store Instructions. By means of these instructions, the contents of the accumulator are transferred to a variable storage location. There are two store instructions.

4/n - Store the contents of the accumulator in storage n (any storage 1 thru 15) and clear the accumulator.

5/n - Store the contents of the accumulator in storage n (any storage 1 thru 15), but do not clear the accumulator of the unit.

Note: It should be remembered that when entering data into a storage location, the previous contents of the storage are erased. Also, on all transfers from the accumulator as well as to it, the full capacity of the accumulator and the storage is transferred.

Shift Instructions. These instructions are used to shift the contents of the accumulator a specific number of decimal positions left or right. A shift instruction is also used to clear the accumulator completely. There are three shift instructions.

6/- - Clear accumulator. This program instruction does not have an address portion. The absence of an address in this instruction directs the accumulator to shift its contents 16 positions to the left, which clears the accumulator completely.

6/n - Shift the contents of the accumulator n (1 to 15) positions to the left.

7/n - Shift the contents of the accumulator n (1 to 15) positions to the right.

Input Instructions. The input instructions are used to enter factors, either manually from the keyboard or automatically from reading tape, into the Central Processor. There are 12 input instructions.

8/1 - Enter data from manual operation of the Flexowriter keyboard under LRD pattern number 1.

8/2 - Enter data from manual operation of the Flexowriter keyboard under LRD pattern number 2.

8/3 - Enter data from manual operation of the Flexowriter keyboard under LRD pattern under 3.

8/4 - Enter data from manual operation of the Flexowriter keyboard under LRD pattern number 4.

8/5 - Enter data from manual operation of the Flexowriter keyboard under LRD pattern number 5.

8/6 - Enter variable length data from manual operation of the Flexowriter keyboard under E.O.W. control. This entry must be followed by an end-of-word signal.

8/11 - Enter data from reader under LRD pattern number 1.

8/12 - Enter data from reader under LRD pattern number 2.

8/13 - Enter data from reader under LRD pattern number 3.

8/14 - Enter data from reader under LRD pattern number 4.

8/15 - Enter data from reader under LRD pattern number 5.

8/16 - Enter variable length data from reader under E.O.W. control. This entry must also be followed by an end-of-word code.

Output Instructions. These instructions are used to transmit the contents of the accumulator to the Flexowriter where they can be printed, or printed and punched in tape, or only punched in tape. Output instructions are also used to control Flexowriter functions, including the printing of letters. There are 20 output instructions.

9/1 - Prints out contents of the accumulator under LRD pattern number 1.

9/2 - Prints out contents of the accumulator under LRD pattern number 2.

9/3 - Prints out contents of the accumulator under LRD pattern number 3.

9/4 - Prints out contents of the accumulator under LRD pattern number 4.

9/5 - Prints out contents of the accumulator under LRD pattern number 5.

9/6 - Tabulate.

9/7 - Carriage Return.

9/8 - Space.

9/9 - Causes printing of a % sign.

9/10 - Turns on Flexowriter punch.

9/11 - Turns off the Flexowriter punch and any auxiliary output unit.

9/12 - Causes printing of U.

9/13 - Causes printing of C.

9/14 - Causes printing of M.

9/15 - Causes printing of S.

9/16 - Causes printing of T.

9/17 - Causes printing of G.

9/18 - Turns on auxiliary output unit.

9/19 - Print restore. This instruction terminates a non-print condition and restores printing to the Flexowriter. The print restore function does not cause a code to be punched in the tape, therefore it is non-reproducing.

9/20 - Non-print. This instruction places the Flexowriter in a non-print condition. The non-print instruction does not cause a code to be punched in the tape, therefore it is non-reproducing.

Program Selector Instructions. These instructions are used to select alternate program lines and to modify program instructions. This is done by transferring program selectors 1 and 2 if the contents of the accumulator are less than zero when the instructions are executed. Program selector instructions are also used to reset program selectors 1 and 2 to normal. There are four program selector instructions, as follows.

10/1 - Transfer program selector number 1 on the condition that the contents of the accumulator are less than zero (A<O). When this instruction is executed by the 6010, the accumulator is tested immediately. If the A<O condition exists, program selector number 1 will transfer at the end of the program line. No transfer will take place if the contents of the accumulator are greater than zero.

10/2 - Reset program selector number 1 to normal. This instruction will not reset program selector number 1 immediately, but reset will occur at the end of the program line which contains this instruction.

10/3 - Transfer program selector number 2 on the condition that the contents of the accumulator are less than zero (A<O). When this instruction is executed by the 6010, the accumulator is tested immediately. If the A<O condition exists, program selector number 2 will transfer at the end of the program line. No transfer will take place if the contents of the accumulator are greater than zero.

10/4 - Reset program selector number 2 to normal. This instruction will not reset program selector number 2 immediately, but reset will occur at the end of the program line which contains this instruction.

Note: Since transfer of program selectors 1 and 2 takes place at the end of the program line containing the 10/1 or 10/3 instruction, the selection of the alternate program will be made in the normal sequence of operations. A program selector which has been transferred at the end of a prior program line can, in a following program line, be reset and set again by A < O determination. At the end of this second program line, the selector will either be reset or transferred according to the last effective instruction.

Program Key Release Instruction. This instruction is used to release program keys 1 thru 12. Its purpose is to terminate an actuator controlled program. Although this instruction can be executed at any position in a program line, the actual key release occurs at the completion of that program line. There is only one key release instruction, as shown below.

10/5 - Release program keys 1 thru 12.

Iterate Instructions. These instructions are used to conditionally or unconditionally return to step number one of the same program line in which they are executed. All iterative operations are immediate. There are three iterative instructions.

10/6 - Immediately return to step number one of the same program line. This must be the last instruction in a program line.

10/7 - Immediately return to step number one of the same program line on the

condition that the contents of the accumulator are less than zero (A < O). If this condition does not exist, the 6010 will ignore the instruction and carry out the balance of the program line.

10/8 - Immediately return to step number one of the same program line on the condition that the contents of the accumulator are greater than or equal to zero (A ≧ O). If this condition does not exist, the 6010 will ignore the instruction and carry out the balance of the program line.

Note: Conditional iterative operations will be repeated in a program line as long as a determined condition prevails. Once the iterative condition no longer prevails, the 6010 will ignore the iterative instructions and execute the balance of the program line.

Jump Instructions. These instructions are used to connect two program lines together, avoid a balance of a program line and to select alternate program lines. Jump instructions cause a conditional or unconditional jump from one program line to the first step of another program line by transferring program selector number 2. All jump instructions are executed immediately, thereby terminating the program line at the step the qualified conditional or unconditional jump was programmed.

10/9 - Immediately jump to step number one of the program line selected by program selector number 2. This is an unconditional jump instruction and is used to link two program lines together. However, it is not possible to connect more than two program lines together. The 10/9 instruction must always be the last instruction in a program line.

10/10 - Immediately jump to step number one of the program selected by program selector number 2, on the condition that the contents of the accumulator are less than zero (A < O). This instruction can occur anywhere in a program line. And if the A < O condition exists, the jump occurs immediately, thereby terminating the program line at that step.

10/11 - Immediately jump to step number one of the program line selected by program selector number 2, on the condition that the contents of the accumulator are greater than or equal to zero (A ≧ O). This instruction can occur anywhere in a program line. And if the A ≧ O condition exists, the jump occurs immediately, thereby terminating the program line at that step.

Note: Since transfer of program selector number 2 is immediate in jump operations, it is not necessary to call for the new program line through a program code or key-actuator combination. Program line selection is automatic, and is established by wiring program selector number 2. The resetting of this program selector is automatically accomplished at the end of the selected program line. When the 10/10 and 10/11 instructions are executed, and the jumping condition is not fulfilled, the 6010 ignores the jump instruction and executes balance of the program line.

Additional Functional Output Instructions. These output instructions are used to control Flexowriter functions, to punch special codes in the tape and to regulate program control. Some of these instructions are unassigned and are available to the programmer for specific use in an application. There are 20 functional output instructions.

11/1 - Switches reading control to the auxiliary reader. However, this instruction does not initiate tape reading. As a by-product of the switching operation, the 11/1 instruction can punch a PI 1 code (2-3-5) in tape, providing the punch has been previously conditioned on and the Flexowriter is in non-print condition. Punching of the PI 1 code will always switch reading control

to the auxiliary reader even though the Flexowriter is in non-print.

11/2 - Initiates a start read condition in the Flexowriter reader. When an auxiliary reader is cable-connected to the system, this instruction will switch reading control to the Flexowriter reader. As a by-product of the switching operation, the 11/2 instruction can punch a switch code (2-3-4) in tape, providing the punch has been previously conditioned on and the Flexowriter is in non-print condition. Punching of the switch code will always switch reading control to the Flexowriter reader even though the Flexowriter is in non-print.

11/3 - Conditions the skip tab function. As a by-product, the 11/3 instruction can punch a PI 3 code (2-4-6) in tape, providing the punch has been conditioned on and the Flexowriter is in a non-print condition. The PI 3 code, when punched on command from the Central Processor, will always condition the Flexowriter for skip tab.

11/4 - Initiates tape skip on the Flexowriter. This instruction permits skipping of all data and functional codes (including 6010 program codes) in tape or cards, until a tape skip restore code is sensed. As a by-product of the tape skip function, a PI 2 code (2-4-7) can be punched in tape if the punch is on and the Flexowriter is in non-print condition. Under this condition, the Flexowriter will be in a simultaneous non-print/tape skip condition. This non-print/tape skip condition will be terminated by a Print Restore code.

Note: The Flexowriter must be wired to accept a Print Restore code to restore to normal read from the tape skip function.

11/5 - Places the Flexowriter in a FC ON condition if the punch control switch is in select position. As a by-product of this function, the 11/5 instruction will punch the FC ON code (2-3-4-5-7) in tape if the punch has previously been conditioned on, and the Flexowriter is in non-print condition. The 11/5 instruction, when executed by the Central Processor, will always supersede keylever punch control. Punches that are turned on by keylever control will not be turned off by activating field control. However, they will be controlled by actuators after initiation of field control condition.

11/6 - Stops all reading. As a by-product of this function, the stop code (1-2-4) can be punched in tape, providing the punch is on and the Flexowriter is in a non-print condition. When a stop code from this instruction is punched in non-print, the reading condition will be terminated. However, before the program line is completed, a 9/19 (print restore instruction) should be used.

11/7, 11/8, 11/9 } Unassigned.

11/10 thru 11/16 } To be used for future technological advances.

11/17 - Keyboard lock (when installed).
11/18 - Keyboard unlock.

11/19 - This instruction switches 6010 program control from field program control (actuator positioning) to tape control. However, it is necessary to condition the appropriate reader on prior to executing this instruction. The 11/19 instruction must be the last instruction in the program line. This instruction should not be used in a program line where it will be executed when the

Flexowriter carriage is on a program start actuator.

11/20 - This instruction switches 6010 program control from tape control to field control (actuator positioning). The 11/20 instruction must be given prior to moving the Flexowriter carriage into contact with the program start actuator. This instruction must also be the last instruction in the program line.

PROGRAMMING PRINCIPLES

The primary task of the programmer is to translate problem language into computer language. To accomplish this, it is necessary to have a detailed knowledge of the components of the 6010 and how they function in relation to each other from a programming point of view. To develop a program, the programmer must know:

1. The number of operations available in the system, and their functions.
2. The procedure itself which must be translated into step-by-step computer instructions.
3. The requirements which must be met as a result of this processing.

Because each problem consists of different but related parts, the programmer must develop a logical sequence for each series of operations to arrive at an efficient solution.

Procedures. Listed below are the steps which should be followed when programming the Friden 6010 Electronic Computer:

1. Analyze application requirements.
2. Allocate LRD patterns and storage locations.
3. Prepare block diagram of system.
4. Write program instructions.
5. Refine program.
6. Wire program panel.
7. Check out program.

Analysis - The system is analyzed to determine requirements from a procedural point of view, and what methods must be utilized to arrive at an adequante solution according to the requirements of the application. Basically this means determining the number of totals desired, what data must be captured in output media for future use, forms design, etc.

Allocation - After determining the requirements of the application, left and right of decimal patterns and storage locations are assigned by the programmer. This simply means that specific storage locations will be assigned for specific functions such as working, totalling, fixed data, etc. Also, decimal control of fixed length numerical input and output data will be assigned to the five LRD patterns.

Block Diagram - A block diagram is a graphic representation of the procedures by which data are processed within a system. The emphasis is on the operations and decisions necessary to complete the process. Standardized symbols have been established to simplify the problems of identifying various programming information. The Friden Code and Flow Charting Template can be used to represent the specific programming symbols illustrated in figure 19.

Coding - Using the block diagram as a guide, the programmer can now write the instructions for this application in actual machine coding. The process of listing the program steps is commonly referred to as coding. During this process the programmer must determine what instructions are available to cause the 6010 to perform each of the logical and arithmetical processes required by the problem.

Refinement - After the coding process has been completed, the programmer can refine the entire program. Program refinement consists of establishing subroutines

in terms of available program lines and frequency of use. Then, the final assignment of program codes and actuator channel-program key combinations can be made.

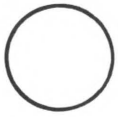
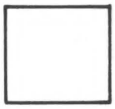
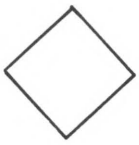
SYMBOL	DESCRIPTION
	START
	OPERATOR ENTRY
	COMPUTING FUNCTION
	LOGIC FUNCTION
	STORAGE
	PRINT OUT
	SPECIAL FUNCTION (i.e. ERROR HALT)
	READ OR PUNCH (Indicate RDR or PNCH No. 1 or 2; non-printed or not)

Figure 19. 6010 Programming Symbols.

Wiring - Wiring of the program panel is the next logical step in the programming process. The instruction sheet serves as an invaluable guide to the programmer for this task. It provides all the detailed programming data in a convenient form to facilitate wiring of the program panel for all Central Processor operations.

Checking - The final step in the programming process consists of checking out the program panel for accuracy of wired instructions. This is normally accomplished by placing the 6010 in single-step mode of operation, then visually checking the operation-display panel, as well as any printed results as each instruction is executed. All routines including error and exception conditions should be checked out, and any necessary corrections made.

To facilitate program checkout, a "test" panel can be temporarily cable-connected to the Central Processor. A series of indicator lights on this panel show the instruction (operation and address) to be executed, and the contents of the accumulator. This device provides the programmer with a detailed view of what is occuring in the 6010 as each program instruction is executed.

SAMPLE APPLICATION

The remaining portion of this section shows how the Friden 6010 Electronic Computer programming principles and instructions are applied in the programming of a simple application. This application requires the multiplication of a quantity (2.0 digits in length), entered through the Flexowriter keyboard, by a price (2.3 digits in length) automatically read from an edge card. The result of this multiplication is rounded off to the nearest cent. And the extension (5.2 digits in length) is printed on a document, and also accumulated for a final total.

For simplicity of explanation, it will be assumed that the application requirements and form design have been established, and that storage locations and LRD patterns have been allocated. Quantity, price and total amount are under decimal (LRD) con-

trol. An accumulated total of 150.00 (from a previous computation) is present in variable storage S-3; and a fixed factor of .005 (for round off purposes) is wired into storage location S-16. The 6010 will tab from quantity to price, and from price to description. A carriage return function will be performed at the end of the line. Figure 20 illustrates the basic form design, and the storage and LRD allocations required for this sample application.

The next step in the programming procedure is to prepare a block diagram of the system. Figure 20 shows the block diagram for this sample application which visually represents the basic 6010 functions required. These machine functions are described below:

1. Clear the accumulator through a SHIFT instruction.

2. Enter quantity (LRD-1) into the accumulator by an INPUT instruction.

3. In order to make the accumulator available to accept the price, it is necessary to temporarily store the quantity in variable storage S-1, and to clear the accumulator. This is accomplished by a STORE instruction.

4. A second INPUT instruction causes the price (LRD-2) in the edge card to be entered into the accumulator.

5. A MULTIPLY instruction is used to multiply the price in the accumulator by the quantity in variable storage location S-1.

6. The product in the accumulator must be "rounded off" by adding a 5 (from storage S-16) in the fourth decimal position. This is accomplished by an ADD instruction. Also, to eliminate insignificant digits from the product, SHIFT instructions must be performed. (These are not shown in the sample block diagram.)

7. The OUTPUT instruction prints out the contents (amount/LRD-3) of the accumulator to the document.

8. Following a print out, the accumulator still contains the product; therefore previous extensions (from storage S-3) can be added for totalling purposes. This is accomplished by an ADD instruction.

9. Totals are stored into location S-3 by a STORE instruction. This instruction also clears the accumulator of the Friden 6010 Electronic Computer.

Upon completion of the block diagram, the actual program instructions can be written. This is accomplished by using the block diagram as a guide, and listing the 6010 instructions necessary to accomplish the required operations. Figure 21 (page 34) contains the proper programming instructions, listed in order, for completion of the required line extension.

After the program instructions have been written, they must be refined. In this case, this simply amounts to assigning program lines based on the number of instructions needed to perform the required operations. Also, program codes or key-actuator combinations, if desired, are assigned by the programmer at this time.

Input media for this application is in the form of an edge-punched card. This card is illustrated in figure 21. It contains the required program codes, the item price, item description and all necessary Flexowriter functional codes.

With the TPS key in operated position, the operator merely touches the START READ panel switch as in normal Flexowriter operation. The 6010 will stop for entry of quantity, resume automatically and complete the line.

The program panel wiring for this sample application is described in detail in Section VI of this manual.

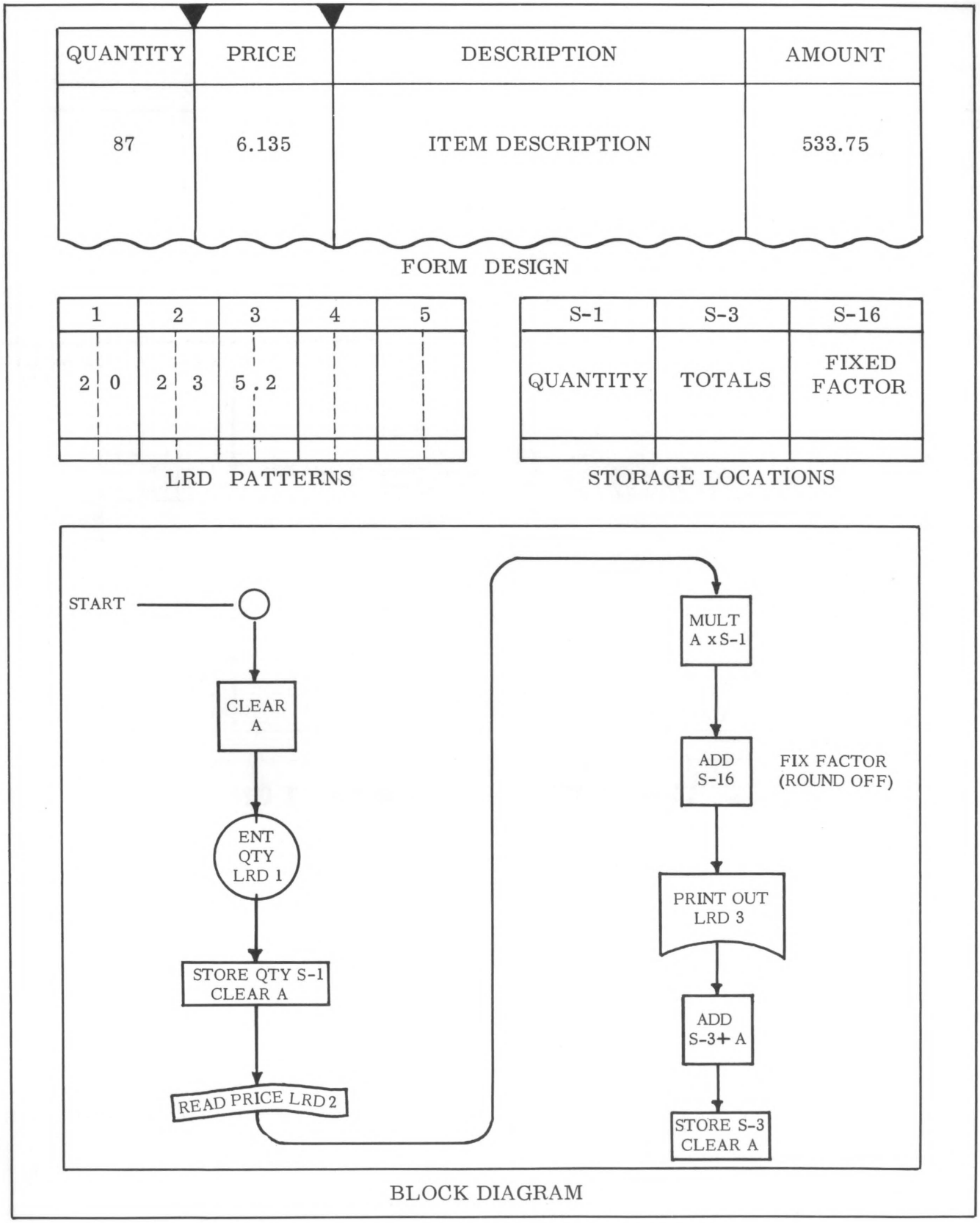


Figure 20. Sample Application - Programming Aids.

FRIDEN 6010 COMPUTER PROGRAM INSTRUCTIONS

CUSTOMER APPL'N: NET EXTENSION DATE PAGE 1 OF 1

PROGRAMMER

NOTES - STEP NO.		INSTR. OPN	INSTR. ADR	DESCRIPTION	ACCUMULATOR
PC-1 PL-K	1	6	–	CLEAR ACCUMULATOR	Ø
	2	8	1	ENTER QTY. FROM KEYBOARD LRD 1 (2-0)	87
	3	4	1	STORE ACCUMULATOR CONTENTS IN S-1 CLEAR ACCUMULATOR	Ø
	4	9	6	TAB TO PRICE FIELD	Ø
	5	8	12	ENTER PRICE FROM TAPE LRD 2 (2-3)	6135
	6	9	6	TAB TO DESCRIPTION	6135
PC-2 PL-0	1	3	1	MULTIPLY (ACCUMULATOR TIMES STORAGE S-1)	533745
	2	1	16	ADD FIX FACTOR 5 IN 4TH POSITION OF ACCUMULATOR (ROUND OFF)	533750
	3	7	4	SHIFT RIGHT 4 POSITIONS	53337 5
	4	6	4	SHIFT LEFT 4 POSITIONS	533 75
	5	9	3	PRINT OUT EXTENSION LRD 3 (5.2) TO FLEXOWRITER	533 75
	6	1	3	ADD STORAGE S-3 TO ACCUMULATOR	683 75
	7	4	3	STORE RESULTS IN S-3 CLEAR ACCUMULATOR	Ø
	8	9	7	CARRIAGE RETURN	Ø

			CR	PC 1	SP	6.135 ITEM DESCRIPTION	TAB	PC 2	STP			

Figure 21. Sample Application - Program Instruction Sheet and Input Card.

SECTION VI
PROGRAM PANEL WIRING

GENERAL

Control and direction of all 6010 functions are accomplished by means of the wired program panel. Hubs on this panel serve as exit or entry points for the electrical impulses used in panel wiring. There are 896 double hubs on the 6010 program panel, and these are divided into groups according to operating functions (see figure 29).

The left side of the panel is labeled A thru P vertically, and the top of the panel is numbered 1 thru 56 (in increments of five) horizontally. By using a combination of both these alphabetic characters and numbers as coordinates, the various sections of the program panel can be easily identified. These sections, their function and the wiring rules which must be applied are explained in this section. A sample application, illustrating both programming and wiring is also included.

PROGRAM SELECTION

Selection of programs is made by program codes read from a tape or by depression of a program key combined with actuator positioning on the field control rack. Each technique may be used according to application requirements. To select a program line, hubs from either the Program Code or Field Control sections of the panel must be wired to the Program Line hubs (D-P, 30-31). These hubs act as a pick-up command for the appropriate program line.

Program Code Selection. When a program code is read from tape, an electrical pulse is available at the corresponding hub in the Program Code section (O-P, 17-29).

Program Key-Actuator Selection. A program key-actuator combination produces a pulse in a corresponding hub in the Field Control portion of the panel (E-J, 19-29). Hubs within this section are numbered horizontally from 1 to 11, and are equivalent to the eleven manual program selection keys on the program key bank. Vertically, there are six rows of double hubs (A-F) which represent 6 (5-10) channels on the field control rack.

Wiring Rule. Connect the hub corresponding to a program code or a key-actuator combination with the hub corresponding to the required program line (see figure 22).

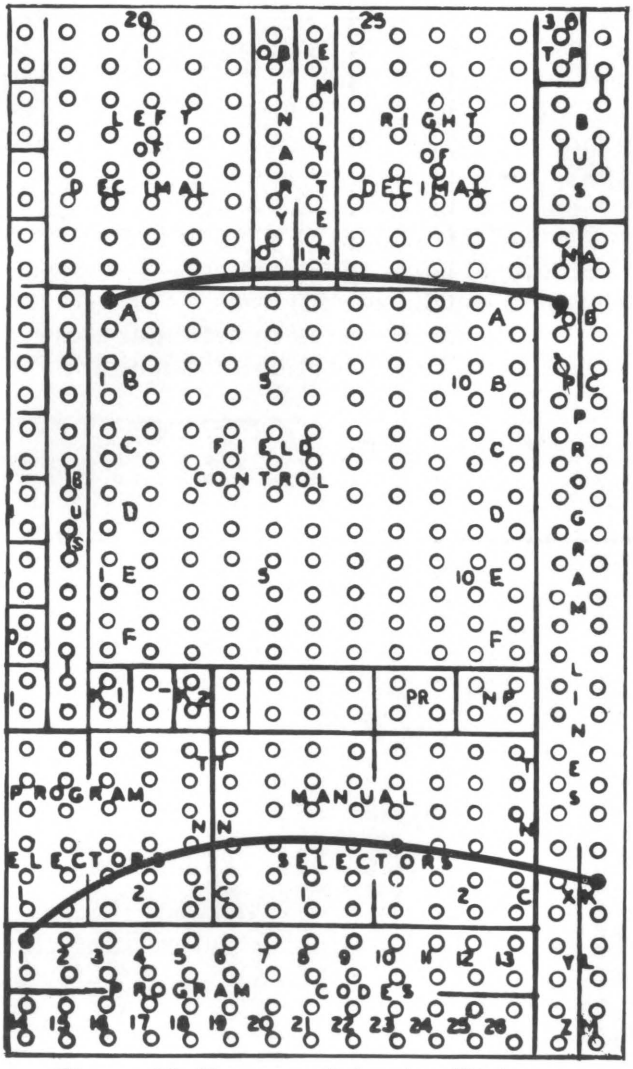


Figure 22. Program Selection Wiring.

INSTRUCTIONS

Once the selected program line is energized, the unit is conditioned to carry out individual instructions on that line. Each instruction consists of an operation and an address. Instructions are wired into the panel from the Operation and Address portions to the appropriate Program Levels of the selected program line.

Program Levels (Steps). Each program line is represented by as many hubs as it contains levels or steps. For example, line A contains 15 steps and is represented by 15 hubs in the Operations Program Level (A1-15) section. There are a corresponding number of hubs in the Address Program Level portion of the panel (A32-46).

Operations. There are eleven pairs of double Operation hubs that are allocated to the eleven processing operations of the program. They are located at positions A-K, 16-17 on the program panel.

Address. The Address portion of the panel contains 20 pairs of double hubs which represent 20 address locations (A-J, 47-50). Each address indicates a particular storage to be affected or a particular function to be performed, depending upon the type of operation with which it is paired.

Wiring Technique. As explained, a program instruction contains an operation and an address. Therefore, the programmer must wire each program step with the appropriate operation, and with the address associated with that operation.

For example, in order for the Friden 6010 Electronic Computer to perform instruction 7/4 on the sixth step of program line K, hubs must be wired as follows: K6 to G16 ❶ and K37 to D47 ❷ (see figure 23).

DECIMAL CAPACITIES

Five columns of decimal capacity control hubs are provided for left and right decimal control (LRD) of input and output information. They are located at positions A-D, 18-29 on the 6010 program panel.

Each set consists of four vertical hubs to wire left of decimal capacity (A-D, 18-22); one hub to determine whether the Computer will print a period (decimal point) or not (A25-29); and three vertical hubs to wire right of decimal capacities (B-D, 25-29) (see figure 24).

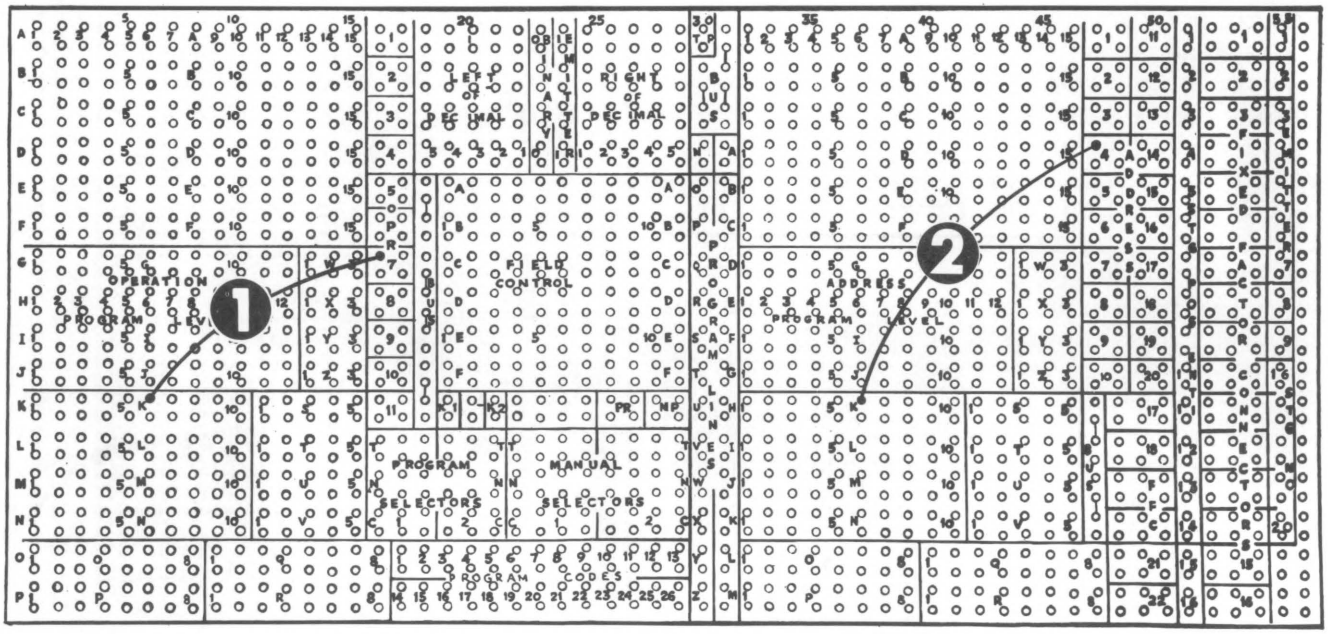


Figure 23. Sample Instruction Wiring - 6010 Program Panel.

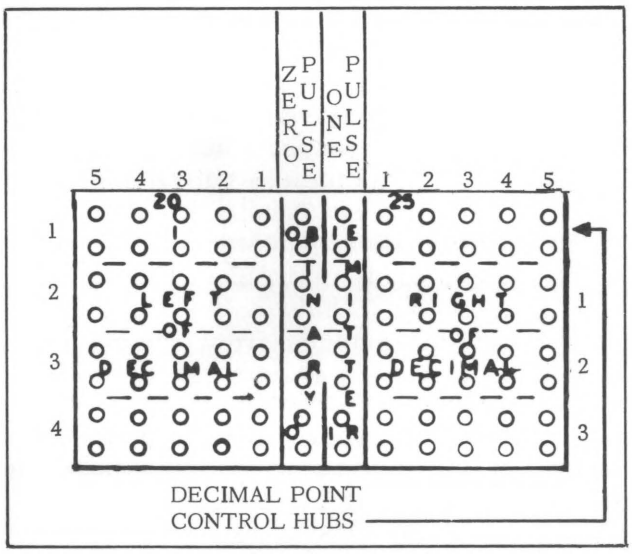


Figure 24. Decimal Capacity Control Hubs.

Binary Emitter. The number of digits left or right of decimal is represented by a binary number (composed of zero and one pulses) which is wired into the program panel. Necessary zero (0) pulses are emitted through a set of hubs located at position A-D 23. One (1) pulses are emitted through hubs at position A-D 24. These hubs are referred to as the Binary Emitter.

Figure 25 illustrates the binary format utilized by the 6010 to represent left and right of decimal numbers. These numbers are shaded and their appropriate binary equivalent appears directly below each number.

binary left										binary right					
10	9	8	7	6	5	4	3	2	1	0	0	1	2	3	4	5
0	0	0	0	0	0	0	0	1	1	1	Print period					
0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1
0	0	1	1	0	0	1	1	0	0	1	1	1	0	0	1	1
0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	0	1

Figure 25. Binary Format Utilized by 6010.

Wiring. There is a definite pattern which must be followed when wiring left and right of decimal configurations to their appropriate capacity control hubs. Binary emitter hubs may not be wired across the dotted lines in figure 24. They must be wired horizontally.

Figure 26 shows the proper wiring of the panel to set up left and right of decimal configurations 2-0 (under LRD control 1) and 3.3 (under LRD control 2). Although there are no digits appearing right of the decimal in the entry (2-0), it is still necessary to wire the binary zero into the panel. Also, since this entry does not require a decimal point, the corresponding hub A 25 is not wired.

The decimal required in the second entry (3.3) is established by wiring the TP hub to the second column of right of decimal capacity control hubs.

DECIMAL CONTROL LRD	CONFIGURATION	BINARY EQUIVALENTS LEFT	RIGHT
1	2-0	1000	010
2	3.3	0111	101

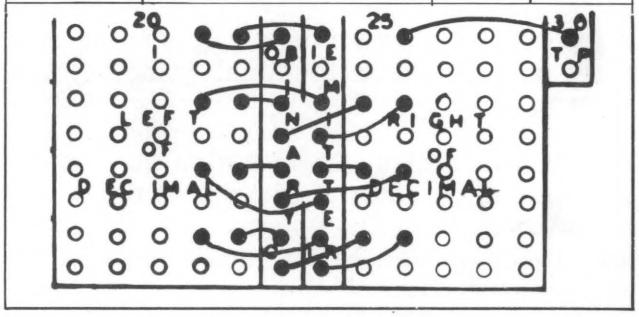


Figure 26. Sample Decimal Control Wiring.

FIXED FACTOR STORAGES

Facilities are provided to store five fixed factors (i.e., any combination of digits 1-9, in any decimal place 1 through 16). In order to wire a fixed factor into a storage location, the following information must be supplied to the computer through program panel wiring:

1. Location of the storage in which the factor must be stored.
2. Digital value of the factor being stored.
3. Decimal position in which the factor must be entered into the storage location.

Storage Locations. Five storage locations are represented by double hubs at positions J-N 55 on the 6010 program panel.

Digital Values. Values from 1-9 are available from nine double hubs located at

positions A-I 55. It is not necessary to wire zero values.

Decimal Positions. The decimal positions of the storage locations are represented by 16 double hubs at vertical row A-P 51.

Connectors. Since there is only one set of hubs available for selecting digital values and decimal positions, it will be necessary to utilize these hubs for several storage entries. This is accomplished by wiring connectors on the program panel.

Twenty-two connector locations provide maximum flexibility for the storage of fixed data. Each set consists of three double hubs. The connectors are located at positions A-P, 52-54 and K-P, 48-50. By using them, it is possible to wire the entry of a selected digit, on a selected decimal position, in a selected storage.

Wiring Principles. Always wire the hubs of the digit to be entered, the decimal position in which it should be entered, and the storage to be loaded to the three hubs of the same connector.

For example, to wire the digit 5 in the first decimal position of storage 17, the hubs would be connected as follows: E 55 to H 54 ❶ , K 55 to H 53 ❷ and A 51 to H 52 ❸ (see figure 27).

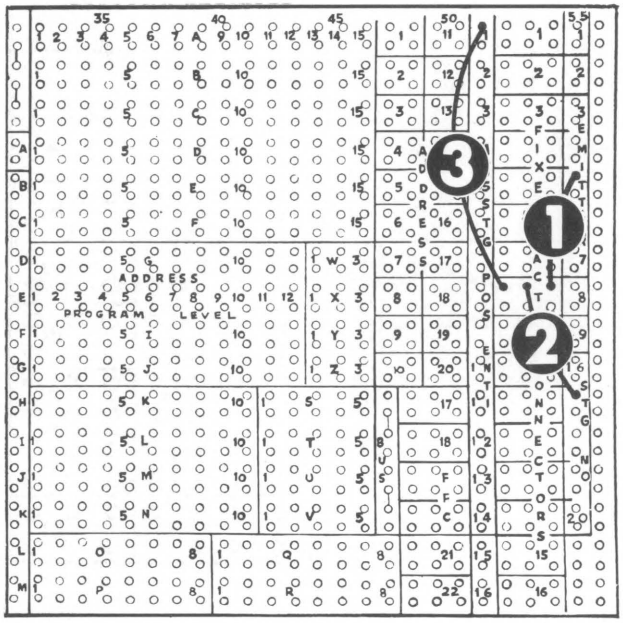


Figure 27. Fixed Factor Wiring Sample.

SELECTORS

The selector hubs on the program panel (L-N, 16-29) are divided into four independently controlled groups. There are three rows of hubs: C (common) hub, N (normal) hub and T (transferred) hub. Normally, the C hub is internally connected to the N hub. When a selector is energized, the connection between the C hub is broken and the contact will be changed from the N hub to the T hub.

Manual Selectors. Two manual selectors are controlled by two corresponding latching keys on the program key bank. These keys, labeled MS 1 and MS 2, are provided for manual Operation and Address modification.

Once energized by the depression of the corresponding program key, the selectors will remain transferred until a carriage return takes place, or the operator depresses the release button for that program key. No special programming instructions need be used in connection with manual selector operation.

Program Panel Wiring. On the program panel, the connection hub of the address program level and the alternate address are wired through one vertical set of selector hubs.

For example, if a selector is wired to transfer to an alternate Address during a program, the wiring may be accomplished as follows: N 22 to N 32 ❶ , M 22 to F 49 ❷ , and L 22 to F 47 ❸ (see figure 28).

Program Selectors. Two program selectors are also provided on the program panel, and they are designed to automatically perform alternate program selection. However, they are generally not energized through depression of program keys, but are controlled by special programming instructions.

ADDITIONAL HUBS

There are several additional hubs on the program panel which provide the program-

mer with greater flexibility. These hubs, their location and functions are briefly explained in the paragraphs below.

Bus Hubs. An internally connected circuit which allows an impulse to be transferred through a series of associated hubs. Bus hubs are located at positions E-K 18, K-N 47, A 31 and B-C, 30-31 on the program panel.

K 1 Hub. This hub, located at position K 19, energizes any external selector working in series with program selector 1.

K 2 Hub. The K 2 hub energizes any external selectors working in series with program selector 2. It is located at position K 21 on the program panel.

Minus (-) Hub. The minus (-) hub enables the appropriate energized selectors to remain transferred in series with internal program selectors 1 and 2. It is located at position K 20.

Non-Print (NP) Hubs. Wiring the non-print (NP) hubs allows the computer to complete the 09/20 programming instruction (non-print). These hubs are located at positions K 28-29.

Print Restore (PR) Hubs. Print restore (PR) hubs are located at positions K 26-27 on the 6010 program panel. Wiring these hubs allows the 6010 to perform instruction 09/19 (print restore).

Tape Control Off Hub. The tape control off hub (K 22) provides a means of returning to field control directly by a program code read in tape. Wiring is from the program code exit to the tape control off hub.

Blank Hubs. The remaining hubs on the program panel have not been assigned a specific function at this time.

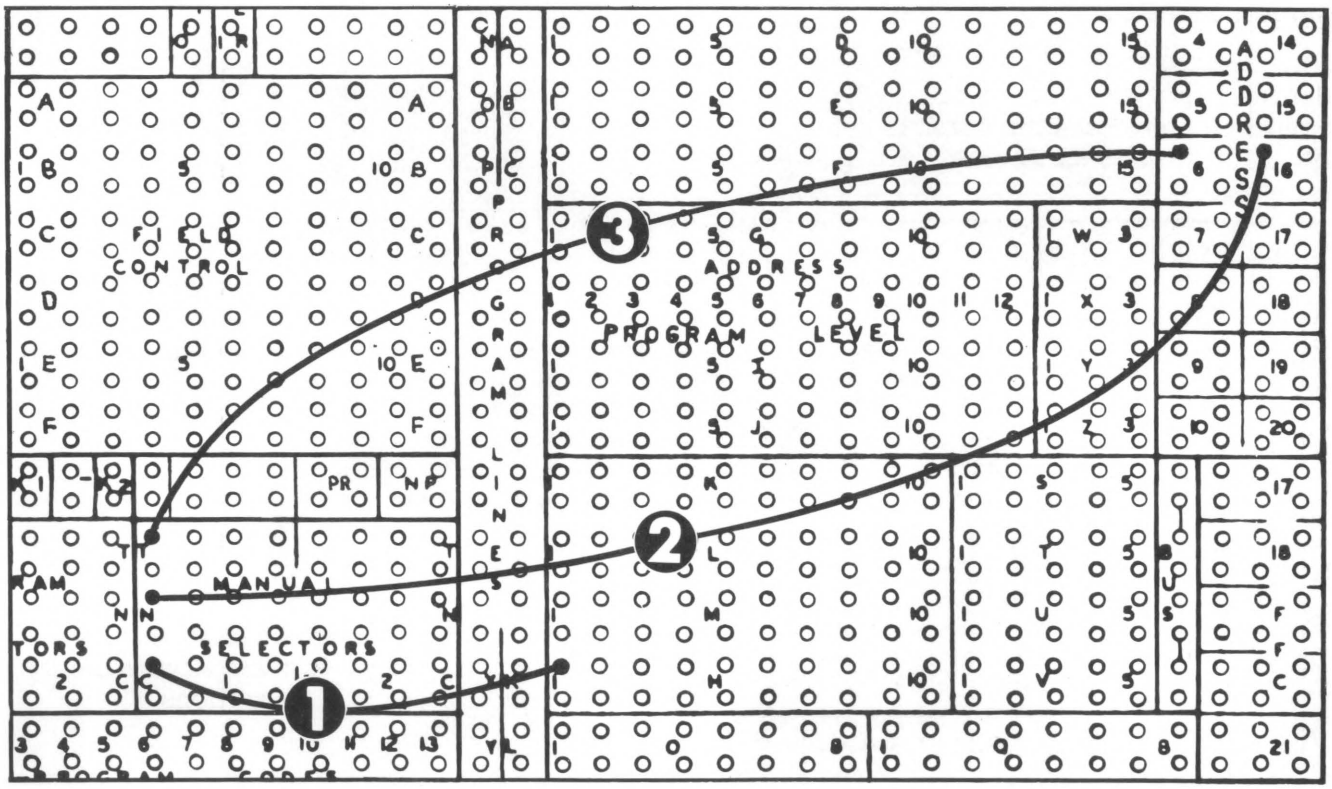


Figure 28. Selector Wiring For Address Modification.

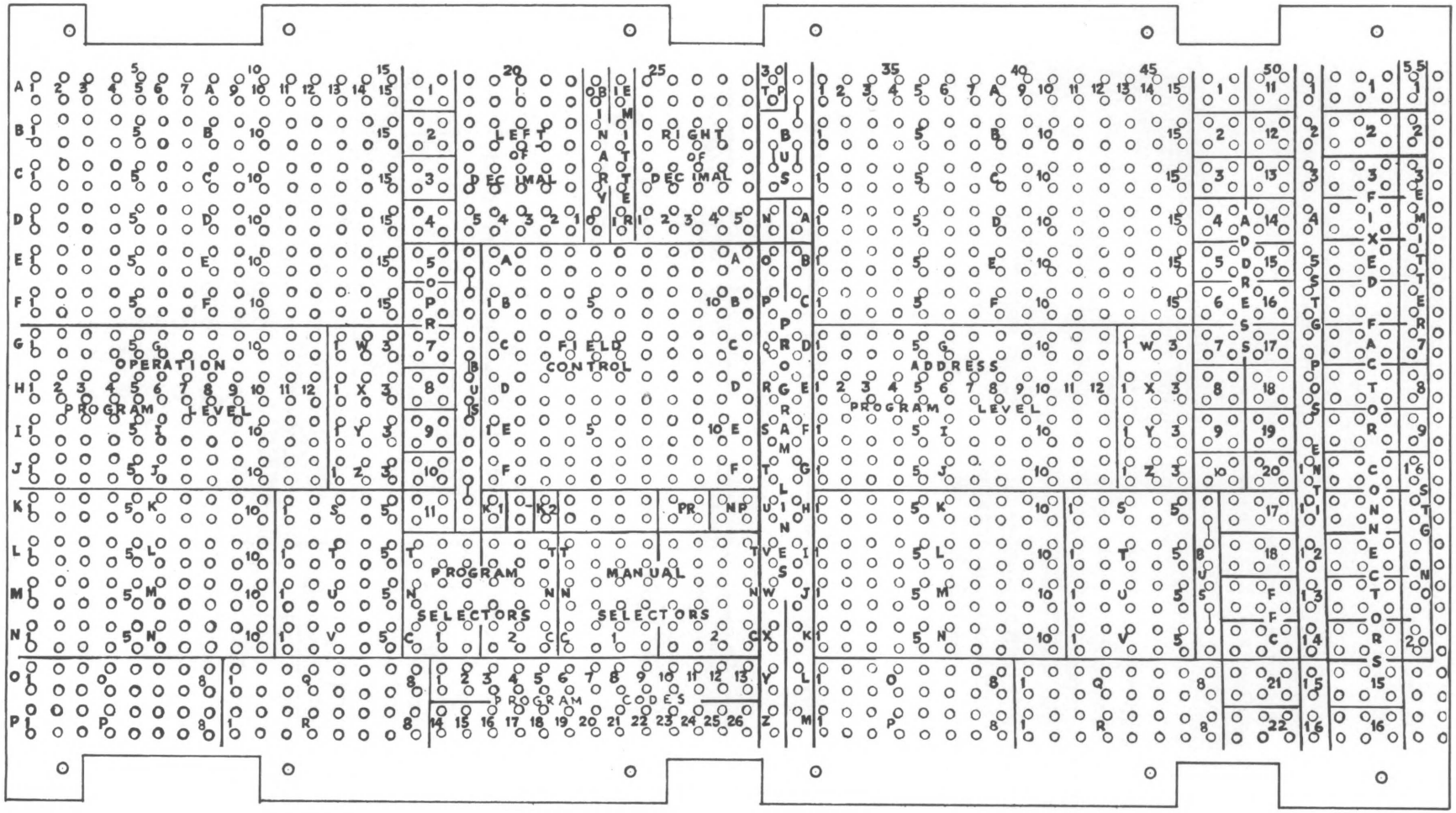


Figure 29. Friden 6010 Electronic Computer Program Panel.

SELECTOR EXPANSION

In some applications it may be necessary to expand the number of hubs available on Program Selectors 1 and/or 2. Should this be necessary, additional selectors can be attached to brackets provided on the program panel. (See supplement on Selectors.)

WIRING APPLICATION

Section V, Program Instructions, described the various instructions, forms and block diagrams which are utilized when programming the Friden 6010 Electronic Computer. The remainder of this section will briefly review the sample application outlined on page 31, and describe the program panel wiring necessary to complete the various programming instructions.

Problem. This application requires the multiplication of a quantity entered through the Flexowriter keyboard by a price automatically read from an edge card. The result of this multiplication is rounded to the nearest cent, printed on the document and added to previously stored total.

As explained, quantity, price and amount entries are under decimal control. In addition, a figure of 150.00 (from a previous computation) is present in variable storage S-3; and a fixed factor of 5 is wired into fixed storage location S-16, decimal position 4.

Card/Document/Program Chart Layout. As a brief review, the proper card, document and program chart layouts are illustrated in figure 30. Instructions on the program layout chart are used as a guide for wiring the program panel.

Program Panel Wiring. The following paragraphs describe the wiring of the 6010 program panel according to information noted on the programming instruction sheet illustrated on the facing page. Each instruction is wired from the required Operation to the appropriate level or step in the Program Line; and from the appropriate Address to the corresponding levels (steps) in the program. Wiring of fixed factor and left and right decimal control (LRD) requirements is also explained in detail (see figure 31).

K PROGRAM LINE - The selection of Program Line K is accomplished by wire ❶.

1. Instruction 6/- (Clear Accumulator) - The operation portion of this instruction is represented by wire ❷ and the address portion is unwired in this particular instruction.

2. Instruction 8/1 (Enter From Keyboard Under LRD 1) - The operation portion of this instruction is represented by wire ❸ and the address portion by wire ❹.

3. Instruction 4/1 (Store In Variable Storage S-1, Clear Accumulator) - The operation portion of this instruction is represented by wire ❺; the address portion by wire ❻ (connected via wire 4).

Note: Because the hubs on the program panel are common, it is possible to transfer an impulse from an operation or an address, at one level of a program line, to another level by jumper wiring. This technique is illustrated by wires on the panel (figure 31) labeled 6, 9, 11, 12, 21, 24, 25, 27, and 28 respectively.

4. Instruction 9/6 (Tabulate) - The operation portion of this instruction is represented by wire ❼ and the address portion by wire ❽.

5. Instruction 8/12 (Enter from Reader Under LRD 2) - The operation portion of this instruction is represented by wire ❾ (interconnected via wire 3), and the address portion by wire ❿.

6. Instruction 9/6 (Tabulate) - The operation portion of this instruction is represented by wire ⓫ (connected via wire 7), and the address portion by wire ⓬ (connected via wire 8).

QUANTITY	PRICE	DESCRIPTION	AMOUNT
87	6.135	ITEM DESCRIPTION	533.75

CR PC1 SP 6.135 ITEM DESCRIPTION TAB PC2 STP

FRIDEN 6010 COMPUTER PROGRAM INSTRUCTIONS

CUSTOMER APPL'N: NET EXTENSION DATE: PAGE 1 OF 1

PROGRAMMER:

NOTES - STEP NO.		INSTR. OPN	ADR	DESCRIPTION	ACCUMULATOR
PC-1 PL-K	1	6	–	CLEAR ACCUMULATOR	Ø
	2	8	1	ENTER QTY. FROM KEYBOARD LRD 1 (2-0)	87
	3	4	1	STORE ACCUMULATOR CONTENTS IN S-1 CLEAR ACCUMULATOR	Ø
	4	9	6	TAB TO PRICE FIELD	Ø
	5	8	12	ENTER PRICE FROM TAPE LRD 2 (2-3)	6135
	6	9	6	TAB TO DESCRIPTION	6135
PC-2 PL-O	1	3	1	MULTIPLY (ACCUMULATOR TIMES STORAGE S-1)	533745
	2	1	16	ADD FIX FACTOR 5 IN 4TH POSITION OF ACCUMULATOR (ROUND OFF)	533750
	3	7	4	SHIFT RIGHT 4 POSITIONS	53375
	4	6	4	SHIFT LEFT 4 POSITIONS	533750
	5	9	3	PRINT OUT EXTENSION LRD 3 (5.2) TO FLEXOWRITER	533750
	6	1	3	ADD STORAGE S-3 TO ACCUMULATOR	683750
	7	4	3	STORE RESULTS IN S-3 CLEAR ACCUMULATOR	Ø
	8	9	7	CARRIAGE RETURN	Ø

Figure 30. Document, Card and Program Instruction Sheet.

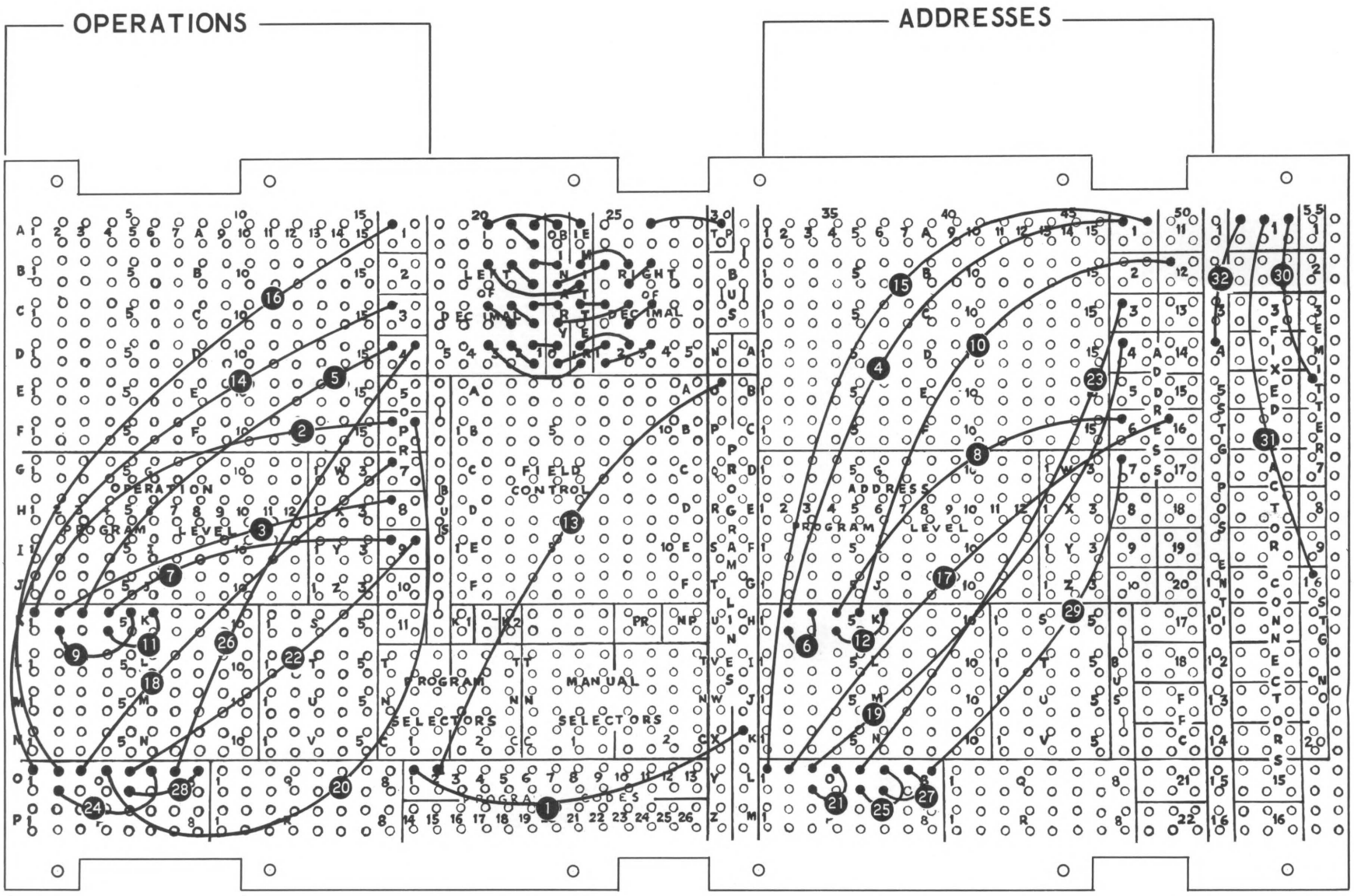


Figure 31. Friden 6010 Electronic Computer - Wired Program Panel.

O PROGRAM LINE - Selection of Program Line O is accomplished by wire ⑬ .

1. Instruction 3/1 (Multiply Variable Storage S-1 By Accumulator) - The operation portion of the instruction is represented by wire ⑭ and the address portion by wire ⑮ .

2. Instruction 1/16 (Add Fixed Storage S-16 To Accumulator) - The operation portion of this instruction is represented by wire ⑯ and the address portion by wire ⑰ .

Note: Fixed factor connector 1 is used to interconnect the digit 5 (wire ㉚) to fixed storage S-16 (wire ㉛) in decimal position 4 (wire ㉜).

3. Instruction 7/4 (Right Shift Four Positions) - The operation portion of the instruction is represented by wire ⑱ and the address portion by wire ⑲ .

4. Instruction 6/4 (Left Shift Four Positions) - The operation portion of the instruction is represented by wire ⑳ and the address portion by wire ㉑ (connected via wire 19).

5. Instruction 9/3 (Readout Under LRD 3) - The operation portion of the instruction is represented by wire ㉒ and the address portion by wire ㉓ .

6. Instruction 1/3 (Add Variable Storage S-3 To Accumulator) - The operation portion of this instruction is represented by wire ㉔ (connected via wire 16) and the address portion by wire ㉕ (connected via wire 23).

7. Instruction 4/3 (Store In Variable Storage S-3, Clear Accumulator) - The operation portion of this instruction is represented by wire ㉖ and the address portion by wire ㉗ (connected via wire 25).

8. Instruction 9/7 (Carriage Return) - The operation portion of this instruction is represented by wire ㉘ (connected via wire 22) and the address portion by wire ㉙ .

Decimal Control Wiring - In this application, the decimal alignment of numerical data, entered to or readout from the Central Processor, is controlled through wiring the Binary Emitter on the program panel. Information on the programming instruction sheet indicates the appropriate LRD requirements for the application. For convenience sake, these are listed below.

LRD DECIMAL CONTROL	REQUIREMENTS	BINARY EQUIVALENTS LEFT	RIGHT
1	2-0	1000	010
2	2-3	1000	101
3	5.2	0101	100

Figure 32 contains a close-up view of the Binary Emitter and all necessary wiring to complete LRD requirements. This wiring is also included in the program panel (see figure 31). However, because of space requirements, individual wirings were not numbered.

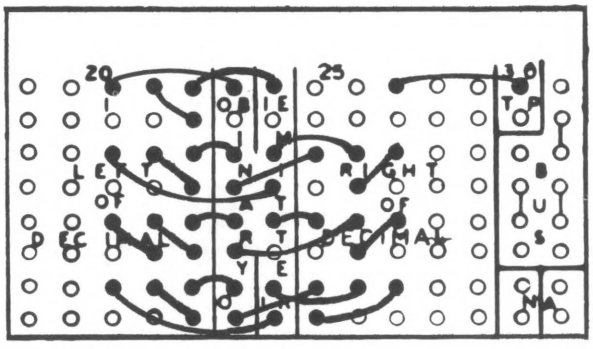


Figure 32. Capacity Control Hubs-Binary Emitter.

SECTION VII
GLOSSARY OF TERMS

ACCESS TIME - The time necessary:

1. To call data from storage.
2. Regenerate it in its original location.
3. Transfer it to the accumulator.

ACCUMULATOR - That part of a computer's arithmetic unit in which sums, totals, and other arithmetic and logical results are developed for further processing.

ACTUATOR - A cam that is attached to the field control rack. It causes an electrical contact to be completed when it touches a field switch roller.

ADDRESS - Indicates a particular storage to be affected or a particular function to be performed, depending upon the type of operation with which it is paired.

ADDRESS CODE - Instruction codes that locate a specific item of data within an auxiliary reader.

ADDRESS IDENTIFICATION CODE - A code used to initiate a search for an address code in a Selectadata Reader.

ARITHMETIC FUNCTION - Any computations performed in the arithmetic unit of a computer.

AUXILIARY INPUT-OUTPUT EQUIPMENT This term includes all data processing equipment which directly supports or services the computer.

BINARY - A characteristic or property involving the choice or condition of two possible alternatives.

BINARY CODE - A system of coding involving two conditions. The absence of a hole (bit) has a significance as does the presence of a hole (bit) in this system.

BINARY CODED DECIMAL - This is a numbering system where the individual digits are represented by some binary code. The most common of these is the 8-4-2-1 coded decimal notation.

BIT - A code hole in punched tape or a magnetically charged code spot on magnetic disc.

CARD PUNCH - A device that punches information in cards under the guidance of an operator or a program. Sometimes referred to as a keypunch.

CENTRAL PROCESSOR - That portion of a computer which contains the arithmetic and logic unit, the control unit, and the internal memory unit. Sometimes it is referred to as "the main frame."

CHARACTER - A character is the basic element of data, alphabetic, numeric, or special symbol.

CLEAR - Load the accumulator or storage location with zeros, destroying previous information.

CODE - A system of symbols or signals for representing information, and the rules for associating them.

COMPLEMENT - The complement of a number is the difference between that number and the next higher power of 10.

COMPUTER - A machine capable of accepting information, applying prescribed processes to the information, and supplying the results of these processes. A machine capable of performing sequences of arithmetic and logical operations.

CONSOLE - See Operation - Display Panel.

CONTROL UNIT - That part of the Central Processor which commands and directs the sequence of operation of a computer.

CORE STORAGE - See Magnetic Core.

CYCLE - A process of action required to perform a single electronic function in a computer operation.

DATA - Any facts or information, especially those which can be used or handled by an electronic computer.

DIGITAL COMPUTER - A computer which uses numbers to express all the variables of a problem.

END-OF-WORD (E.O.W) - Automatically controls positioning of numerical entries within the accumulator to assure their proper decimal alignment.

ENTRY - Information processed by the computer system which is entered from input media, such as tapes or cards, or manually keyboarded through the Flexowriter.

FIELD CONTROL RACK - Consists of 12 vertically spaced control channels. Cams attached to the rack can initiate, sustain and terminate computer programs when carriage position control is used.

HARD COPY - Information placed or written in a form that can be handled and read by humans without the use of special devices. It usually refers to information typed or printed on paper.

HUB - A point on the program panel where electrical pulses are emitted or received through a wire.

HUB, BUS - An internally connected circuit which allows an impulse to be transferred through a series of associated hubs.

HOLLERITH CODE - The standard 12-channel code used in some tabulating card systems.

IMPULSE - An electrical signal transmitted by a component of the 6010 system.

INPUT - Media containing information transferred from an external source into the computer.

INSTRUCTION - Programming requirements which are expressed by combining an operation and an address.

INTEGRATED DATA PROCESSING - The transferring of information from one type of data processing equipment to another by means of common machine language media.

ITERATE - Repetitive use of a series of instructions (refer to jump instructions).

JUMP, CONDITIONAL - Initiation of a new series of program steps automatically, based on a condition which arises during processing.

JUMP UNCONDITIONAL - Automatically initiating a new series of program steps by means of an instruction.

KEYBOARD - Physical portion of writing machine where all manual entries are made.

LOGICAL OPERATION - Performance of comparison, selection, etc., where a test of the high order position (16th) of the accumulator indicates presence or absence of a "9."

MAGNETIC CORE - A ring of ferromagnetic material. Each core may represent a binary bit of data in internal storage.

MEMORY - A device which stores information which can be entered or read out of under program control. Memory usually refers to data storage inside the computer (internal storage).

LEFT/RIGHT OF DECIMAL (LRD) - Controls placement of the decimal within an entry or exit through wiring of the 6010 program panel.

MICROSECOND-One millionth (1/1,000,000) part of a second.

MILLISECOND - One thousandth (1/1,000) of a second.

NON-PRINT - A means of reading or punching data without printing on a document.

OFF-LINE OPERATION - A system of machines or units of accessory equipment not connected to, nor directly controlled by the computer. Peripheral equipment.

ON-LINE OPERATION - A system of machines or units of accessory equipment electrically connected to and controlled by the computer.

OPERATION - That part of an instruction which designates the function to be performed by the 6010.

OPERATION-DISPLAY PANEL - A device containing switches, indicators, and other equipment for controlling the functions of a computer. It is usually part of the Central Processor.

OPERATOR - One who monitors the computer system.

OUTPUT - Information transferred from the computer to an external media.

PARITY CHECK - A check which tests whether the number of binary 1's in a single digit is odd, if odd parity, or even, if even parity.

PERIPHERAL EQUIPMENT - Units which work off-line in conjunction with a computer, but are not physically connected to it. A Friden Flexowriter, Computyper, Add-Punch and Teledata may be used off-line with the Friden 6010 Electronic Computer.

PRINT RESTORE - Returns the typing unit to a normal printing action following an automatic non-print condition.

PROGRAM - A set of instructions and routines arranged to cause the Friden 6010 Electronic Computer to complete a sequence of predetermined operations.

PROGRAM CODE - When this code is read from input media it causes the 6010 to select a corresponding program line.

PROGRAM KEYS - Keys located in front of typing keyboard that set up the pattern of actions for the 6010 to follow.

PROGRAM LEVEL - A program level (step) is a hub on the program line which performs a specific function. The light that is off on the program level display indicates the next step which will be performed.

PROGRAM LINES (A through Z) - Each line is a series of instruction steps which are established by program panel wiring. The light that is out on program lines display indicates program being performed.

PROGRAM PANEL - A removable panel containing electrical terminals interconnected by short wires. It is used to provide specific sequential instructions for all operations of the Central Processor.

PROGRAM SELECTOR KEYS (PS1-PS2) - Located in the 13th and 14th positions on the program key bank. Depression of these keys energizes the transfer row of program selector hubs on the 6010 program panel.

PROGRAM STEP - See Program Level.

READER - Unit for sensing codes in a tape and emitting electrical impulses to the writing machine and/or computer.

READ IN - To place data in the accumulator from an external source.

READOUT - The computer operation of displaying processed information, usually in the form of hard copy.

ROUND-OFF - To delete less significant digits from a number and possibly apply some rule of correction to the part retained.

ROUTINE - A set of instructions arranged in a sequence which directs the computer to automatically perform an operation or series of operations.

SELECTOR - A switching device which may

be set to provide an alternate path for the program operation.

SHIFT - To move the digits in the accumulator one or more places right or left.

SKIP TAB - A means of rapidly reaching a predetermined point on a form by eliminating the intermediate tab stops.

SOLID STATE - Refers to a computer in which principle electronic components are transistors. Contrasts with computers in which principle electronic components are vacuum tubes.

STORAGE CAPACITY - The amount of data that can be retained in the storage or memory unit of a computer.

STORAGE, FIXED - Five locations of 16 digits each which can transmit fixed data to the accumulator under program control.

STORAGE, INTERNAL - Storage facilities within and directly controlled by the Central Processor of the 6010.

STORAGE, VARIABLE - Fifteen locations of 16 digits each which can receive data from or transmit data to the accumulator under program control.

STORAGE, WORKING - A portion of the internal storage reserved for data upon which operations are being performed.

SUBROUTINE - A set of instructions arranged in a sequence which directs the computer to perform an operation or series of operations in the program. The entire computer program is made up of a group of subroutines.

TRANSFER - To convey or store information from one location to another.

TRANSISTOR - An electronic device which performs functions similar to those performed by vacuum tubes.

WORD - A series of digits treated as a single unit by the computer.

WORD LENGTH - The number of characters in a word. Can be fixed or variable, depending upon the storage media and computer.

APPENDIX
PUBLICATIONS AND EDUCATION

SPECIFIC PUBLICATIONS

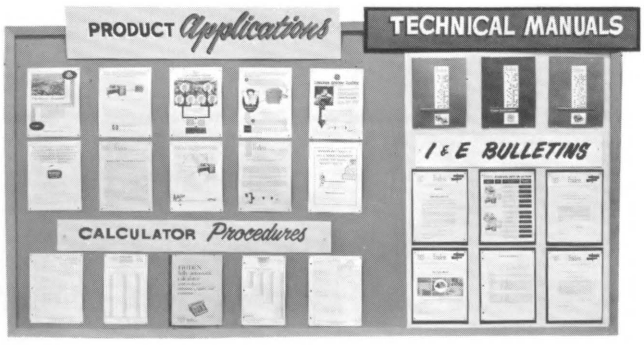
Product publications editorializing actual customer installations of Friden products, commonly called "Case Histories", are available depicting before and after methods, flow chart procedures, and benefits derived from these installations.

These product publications and all other Friden literature may be obtained from Friden Branch offices, located in all major cities, or by writing Rochester, New York.

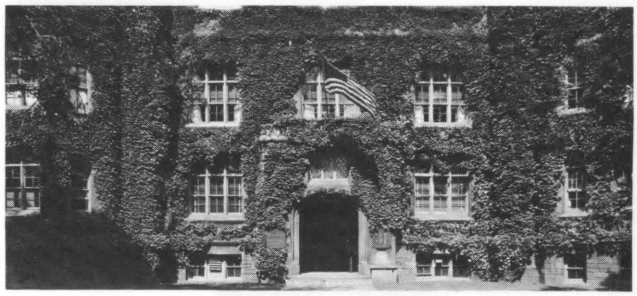
Customer Case Histories cover a wide scope of industries and businesses. Each write-up portrays the methods and equipment that benefited a specific customer in a given area. Many of these well thought-out customer applications may be duplicated or applied to a business operating under similar circumstances.

Technical Manuals, Information and Education Releases (I & E Bulletins) also are available. Friden Technical Manuals provide a sound knowledge of the principles that form the basis and background for Friden equipment. The entire machine or system is taken in a logical sequence and clearly described to aid anyone in achieving a complete understanding of Friden products.

Information and Education Bulletins cover a vast range of information on such subjects as data processing, graphic arts, mailroom methods, data collection and other topics.



Examples of Friden Literature



Friden Educational Center

FREE COURSES AND SEMINARS

Friden, Inc., maintains an Educational Center located in Rochester, New York. This Center, equipped with over a million dollars worth of Friden and allied equipment, directs its activities toward fulfilling the guidance needs of Friden's current and potential customers.

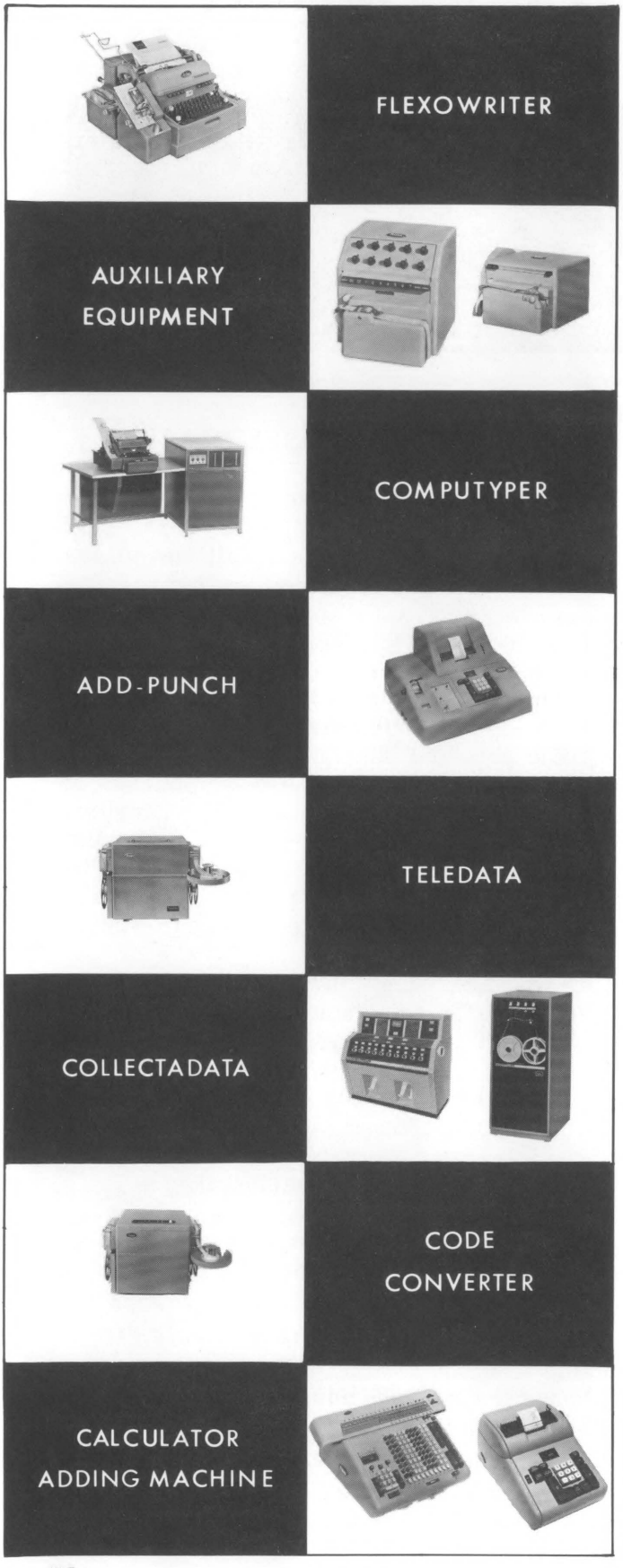
Thousands of systems - procedures - graphic arts and management level personnel have completed one or more courses of study conducted at this Center. The curriculums, which range over the full spectrum of integrated data processing, communications, data collection, graphic arts, and allied areas are scheduled the year-round.

Courses are taught by instructors of the Friden Customer Educational staff, each an expert in his particular field.

To augment regularly scheduled courses special seminars are initiated for organizations whose requirements are restricted to specific equipment or applications.

Enrollment and registration for ALL customer programs will be arranged by the Friden representative or office nearest you. They will gladly make arrangements for you and for any member of your organization who wishes to attend any of the many courses offered. Ask them for the brochure describing and listing the dates of all courses. All courses are conducted FREE of charge.

Friden Products Designed for Practical . . .



DATA PROCESSING EQUIPMENT

The FLEXOWRITER® . . . automatic writing machine, is a tape-operated data processing unit. It automatically produces documents at 100 words per minute, and simultaneously perforates punched paper tapes for further data processing. Many models are available for specific data processing applications.

A wide variety of AUXILIARY, input/output units may be cable-connected to the Flexowriter, Computyper and other Friden equipment. These units facilitate greater application and programming flexibility.

The COMPUTYPER,® automatic writing-computing machine, is a complete billing department at a single desk. It contains all the versatility of the Friden Flexowriter, plus the ability to compute automatically.

The Friden ADD-PUNCH,® 10-key "Natural Way" adding machine with automatic tape punch, captures numeric data for automatic preparation of reports. This unit creates a printed tape as well as a punched paper tape for many data processing applications.

TELEDATA,® data transmission and receiving system, speeds communications to and from remote points over existing wire services. These units have the ability to simultaneously transmit, receive, and check tapes of 5 through 8-channels for a wide range of applications involving communications.

COLLECTADATA,® data collecting system, facilitates fast and accurate reporting from diverse points directly to a data collection center. This transmission and receiving system provides management with up-to-date information on plant operations at all times, thus allowing executive decisions to be based on events as they occur.

The Friden CODE CONVERTER has the ability to convert one punched paper tape coding system to another. This unit reads a tape and automatically produces a similar tape containing identical information in a different coding system. This facilitates compatibility between machines using different coding methods. It processes 5-6-7-8-channel tapes.

CALCULATORS AND ADDING MACHINES

Friden CALCULATORS and "Natural Way" 10-key ADDING MACHINES are leaders in their field. These easy to operate units come in a wide variety of models, thus providing a versatile machine for all businesses, large or small.

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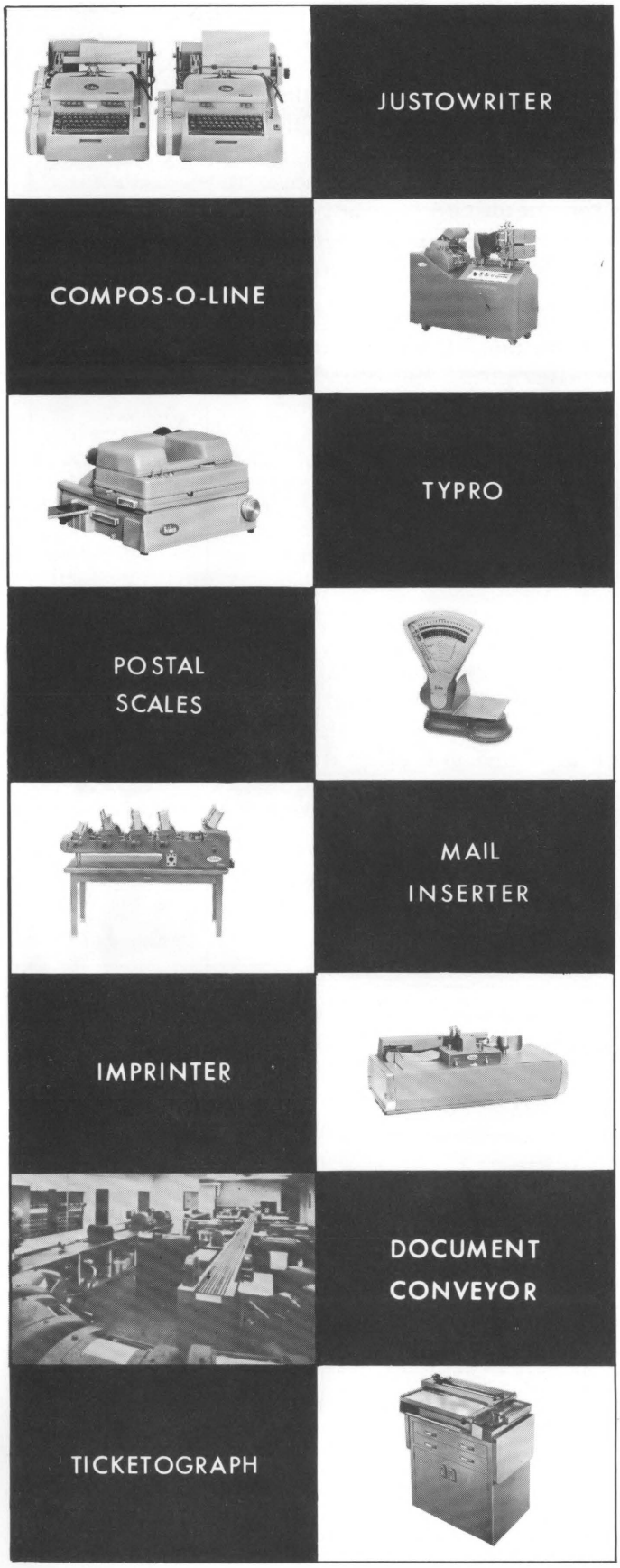
Application in Business and Industry



GRAPHIC ARTS EQUIPMENT

The JUSTOWRITER,® automatic tape operated copy-setting machine, produces justified (even margin) copy for duplicating or printing. This easy-to-operate machine is available in a variety of models that will provide an economical source of high-quality composition.

COMPOS-O-LINE,® Sequential Card Camera, converts original source data from file cards into film negatives ready for the printing of price lists, directories, catalogs, labels, and other similar applications.

Friden TYPRO® is a cold type photo-composing machine used to produce flawless, micro-sharp display type and lettering. This easy-to-operate precision machine holds up to 15 type fonts on one reel. Type sizes range from 6 to 144 points and over 1800 selections are available.

MAILROOM EQUIPMENT

Friden provides a complete line of mailroom equipment to speed mail handling and distribution. This includes a complete line of POSTAL SCALES, sorting racks, mail bags, openers, sealers, and endorsing machines.

The Friden - Ertma MAIL INSERTER automatically gathers and stuffs into envelopes as many as eight different inserts, then seals, stacks, and counts the envelopes ready for mailing.

The IMPRINTER, automatic check endorsing and signing machine, signs, endorses, cancels, counts numbers, dates and imprints checks or other documents at high speed. These operations are performed economically; and safety is insured by the use of locked steel signature plates.

Friden DOCUMENT CONVEYOR eliminates the hand carrying of mail, papers, reports, and other documents. This system moves paperwork economically, smoothly, silently and swiftly to any specific area. The Document Conveyor is tailored to any customer requirements.

TICKETOGRAPH

Mather Division of Friden, Inc. designs and prints coupons or work tickets of all widths, lengths, colors of ink, stock and types of perforations, for all kinds of machines, automatic or manual. TICKETOGRAPH,® gang numbering and pricing machine, imprints piecework rates and production data utilizing these tickets.

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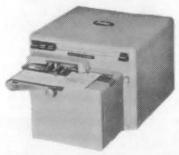
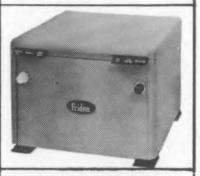
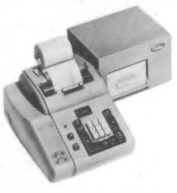
INPUT-OUTPUT EQUIPMENT AVAILABLE WITH THE FRIDEN 6010 ELECTRONIC COMPUTER	OFF-LINE INPUT UNITS - Any machines which produce standard 8-channel punched tape can be used as off-line (unconnected) input units to the Friden 6010 Electronic Computer by supplying tape for the computer to process. These include various models of the Friden Flexowriter and Computyper, the Friden Add-Punch and Teledata, or the machines of other manufacturers.

MODEL	DESCRIPTION	
6012	FRIDEN AUXILIARY TAPE READER - This unit permits introduction of data into the 6010 from a second source. Reading operation alternates between the Auxiliary Tape Reader and the Flexowriter Reader, as required by the application.	
6013	FRIDEN AUXILIARY TAPE AND EDGE-PUNCHED CARD READER - This unit is the same as the Auxiliary Tape Reader, except that it can read edge-punched cards as well as paper tape.	
6014	FRIDEN SELECTADATA READER - Like the Auxiliary Tape Reader, this unit permits introduction of data to the 6010 from a second source. It has the additional capability of searching paper tape and selecting data.	
6015	FRIDEN AUXILIARY TAPE PUNCH - This unit permits punching of a second paper tape, with complete or selected data, as an automatic by-product of the 6010's operation.	
6016	FRIDEN TAB CARD PUNCH CONTROL - This unit enables the 6010 to automatically control an IBM 024-026 Card Punch so that tab cards may be produced as an automatic by-product of the 6010's operation.	
6017	FRIDEN SYSTEM'S RECEIVER SINGLE CASE - This unit permits automatic preparation of a related document at the same time the computer is preparing the original document.	
6019	FRIDEN AUXILIARY ACCOUNTING KEYBOARD - This machine is a compact adding-listing unit which is designed for connection with the Flexowriter Model 6011. It offers advantages of fast 10-key digital entry in systems where the majority of manual entries are numerical.	

FRIDEN FLEXOWRITER CODE CHART

STANDARD TAB CARD PUNCHING POSITIONS												MODEL 6011 SINGLE CASE	MODEL 6011 DOUBLE CASE	STANDARD TAPE CHANNEL NUMBERS								
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											▮	9	9 — (				●	●	·			●
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						▮				▮		NON-PRINT (AUX. SPACE)	NON-PRINT (AUX. SPACE)				●	●	·	●		
		▮				▮				▮		PRINT-RESTR. (AUX. ZERO)	PRINT-RESTR. (AUX. ZERO)			●		●	·	●		
	▮					▮				▮		ON—1	ON 1—ON 2		●			●	·	●		
▮						▮				▮			UPPER CASE		●	●	●	●	·	●		
▮												&	& — ;		●	●	●		·			
		▮						▮		▮		TAB	TAB			●	●	●	·	●	●	
								▮		▮		CONTROL (AUX. 2)	CONTROL (AUX. 2)					●	·	●	●	
		▮							▮	▮		PUNCH OFF	PUNCH OFF			●		●	·	●	●	●
									▮	▮		DATA SELECTOR (AUX. 3)	DATA SELECTOR (AUX. 3)				●	●	·	●	●	●
	▮								▮	▮		FORM FEED (AUX. L)	FORM FEED (AUX. L)		●			●	·	●	●	●
				▮						▮		PI 1 (2, 8, SP)	PI 1 (2, 8, SP)				●	●	·		●	
	▮			▮						▮		PI 2 (2, 8, -)	PI 2 (2, 8, -)		●			●	·		●	
		▮		▮						▮		PI 3 (2, 8, 0)	PI 3 (2, 8, 0)			●		●	·		●	
		▮					▮			▮		PI 4 (AUX. /)	PI 4 (AUX. /)			●	●	●	·	●		●
▮							▮			▮		PI 5 (AUX. A)	PI 5 (AUX. A)		●	●		●	·	●		●
	▮						▮			▮		ADDRESS IDEN. (AUX. J)	ADDRESS IDEN. (AUX. J)		●		●	●	·	●		●
							▮			▮		SKIP RESTORE (AUX. 1)	SKIP RESTORE (AUX. 1)					●	·	●		●
▮				▮						▮			LOWER CASE		●	●	●	●	·		●	
▮								▮		▮		ON—2			●	●		●	·	●	●	
	▮							▮		▮		FC ON			●		●	●	·	●	●	
▮									▮	▮		TAPE FEED	TAPE FEED		●	●	●	●	·	●	●	●
									▮		▮	CAR. RET.	CAR. RET.	●					·			
												BACK SPACE	BACK SPACE		●	●	●	●	·	●	●	●
12	11	0	1	2	3	4	5	6	7	8	9			EL	X	O	CH	8	FEED	4	2	1
														I.B.M.								

Friden, Inc.

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