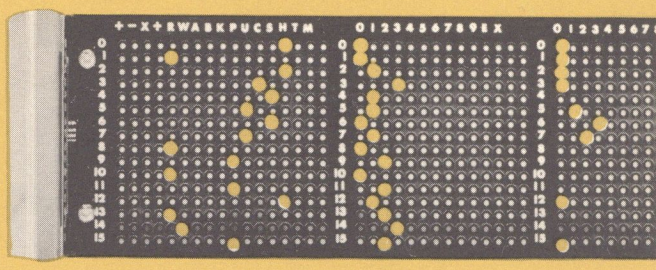
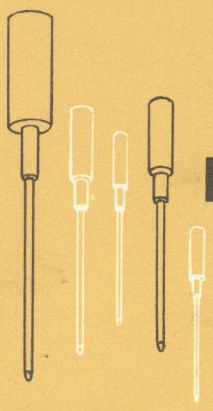
BULLETIN E176A

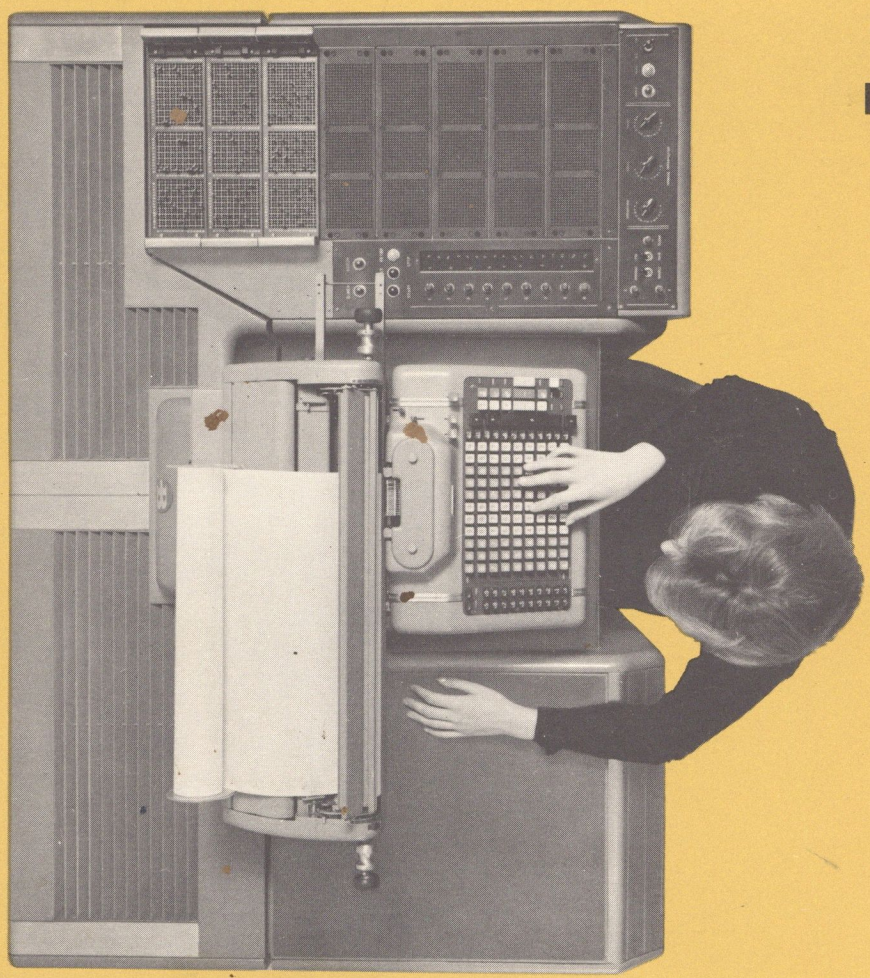




ElectroData 101

HANDBOOK

Operating Instructions



OPERATING GUIDE TO THE
ELECTRODATA 101

You are going to be operating the ELECTRODATA 101 —a desk size, electronic digital computer. It is the first machine to bring the advantages of electronic computation into the area of small calculating problems. Its sole purpose is to take the drudgery out of computing, to allow faster and more accurate solutions to many different arithmetic problems.

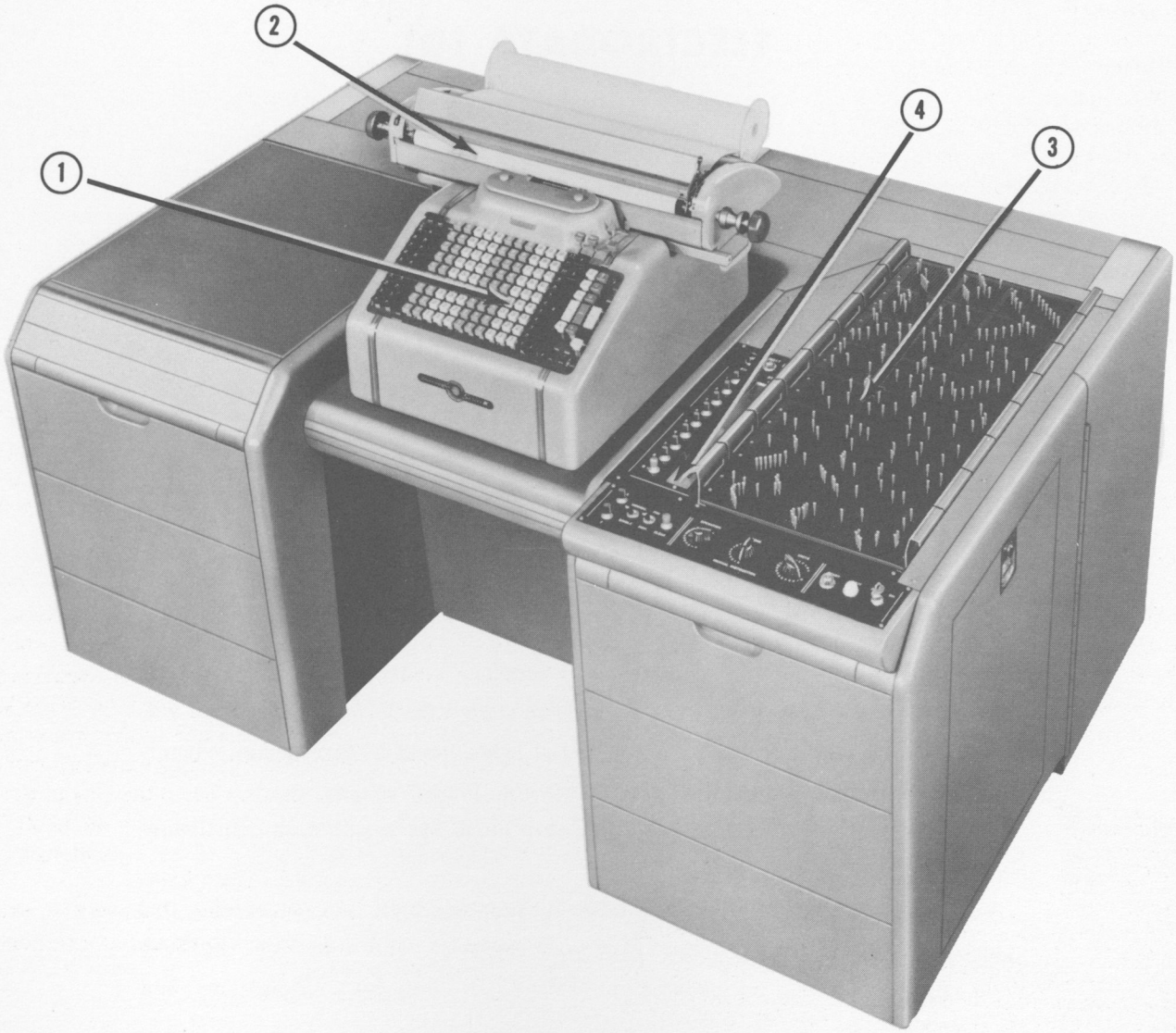
This operating guide tells you in detail how to do the two things needed to solve a typical problem:

1. **How to set up the E101 initially and get it started, and**
2. **How to feed into the E101 the numbers with which it is going to work.**

The part you will play in each particular problem is written out for you on an "Operating Instructions Sheet." Once you have started the E101 to work, you will only be involved in the problem when the E101 lights one of its two signals. When it does, you simply follow the "Operating Instructions Sheet," step by step.

You will find that running the E101 is very much like operating a calculating, bookkeeping, or adding machine.

You will have at your fingertips a powerful precision-built tool. By reading this guide carefully, and asking questions of your supervisor and your ELECTRODATA Field Engineer, you can get the most out of the E101—both for your company, and for yourself.



ELECTRODATA 101

THE ELECTRODATA 101

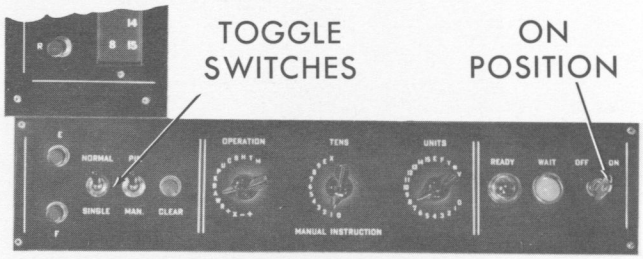
The ELECTRODATA 101 is a general purpose electronic computer designed to solve long, complex, or repetitive problems simply and efficiently. Like all general purpose electronic computers, the E101 is a complete computing system with five basic parts: Input, Output, Memory, Arithmetic Unit, and Program Control. All components of the system are housed in the one unit shown on the opposite page. The parts of the machine of primary interest are:

1. **Keyboard**—This is the Input of the E101, as easy to operate as the keyboard on an adding machine.
2. **Printer**—This is the Output, very flexible and entirely automatic.
3. **Pinboards**—The pinboards are what make it possible for the E101 to perform calculations automatically. They contain direct instructions to the E101 which are expressed by the positions of removable pins placed in the pinboards. The programmer is the person who determines where the pins should be placed.
4. **Control Panel**—The control panel contains the signal lights, OFF-ON key, START buttons and other controls.

A TYPICAL PROBLEM

Turning the E101 "ON"

When the operator is ready to use the E101, he turns the OFF-ON key on the control panel to the ON position. The WAIT light (next to the key) comes on as a signal that the computer is warming up. In a minute, the READY light comes on and the WAIT light goes off. The operator checks the two toggle switches on the left to make sure they are in the NORMAL and PIN positions. Then he depresses the red CLEAR button (to the right of the two switches), and the E101 is ready for computation.



The Operating Instructions Sheet

When solving a problem on the E101, the operator generally obtains two things from the programmer:

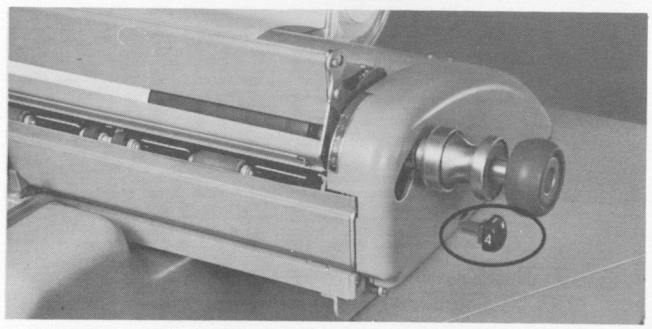
1. The pinboards with the pins in the proper places (these are the instructions to the E101.)
2. An "Operating Instructions Sheet" (these are the instructions to the operator).

A sample "Operating Instructions Sheet" is shown opposite the next page. The first thing the operator does is check the "Pinboards" block to see which pinboards to insert into the E101. There can be from one to eight pinboards depending on the complexity of the problem. In this case, there are six. They are inserted in the machine from back to front in the order in which they are numbered. (The illustration below shows an operator inserting pinboard No. 8.)

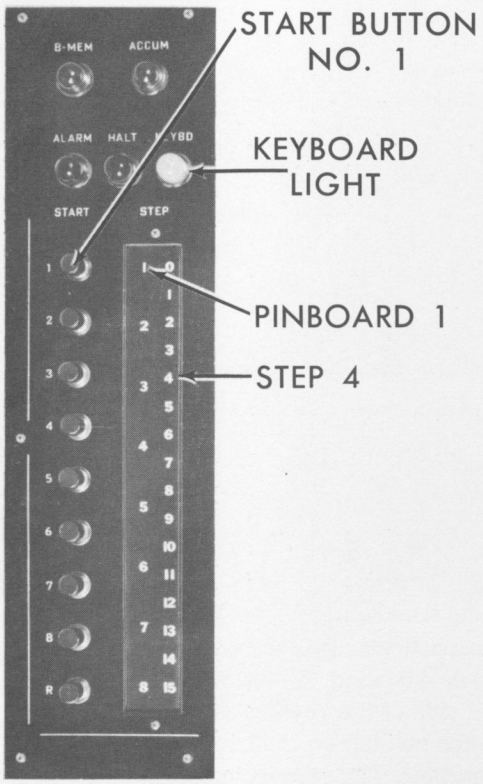
NOTE: Sometimes you may be asked to drop the pins in place in the pinboards before inserting them in the E101. This operation takes but a few minutes and is described on page 6.

The next block on the "Operating Instructions Sheet" is marked "Printing Schedule." It tells the operator which printing schedule or format is to be used for the problem. In this particular case the programmer has specified that schedule 4 be used. All the operator does is turn the knob on the side of the keyboard carriage to the proper number—the number on the knob facing you when seated at the machine. The carriage must be all the way to the left or right as far as it will go in order to turn the knob. The carriage can be moved to either of these positions by depressing the TAB and RETURN keys.

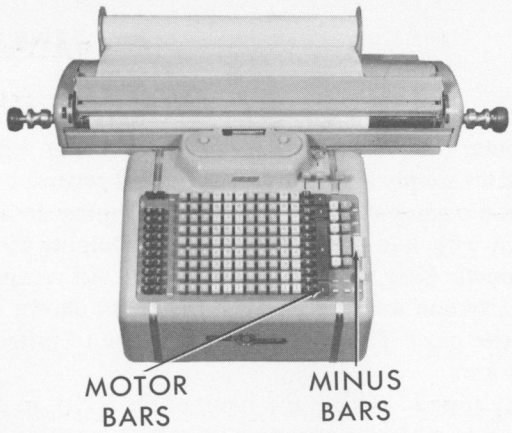
(Note: The E101 is inoperative with the carriage in these positions. It must be returned to operating position before starting the problem.)



The next block calls for "Special Instructions." Since there are none in our sample problem, we'll skip across to the block marked "Start Button." This is the button that signals the E101 to start the problem. Actually, there are 9 START buttons on the control panel, each one sending the E101 to a different part of the problem. The first 8 buttons correspond to the 8 pinboard positions. Depressing START button No. 3, for example, sends the E101 to the first instruction on pinboard 3. Most problems, like the one in our sample, begin with the first instruction on pinboard 1. The operator therefore depresses START button No. 1, and the E101 begins the solution of the problem.

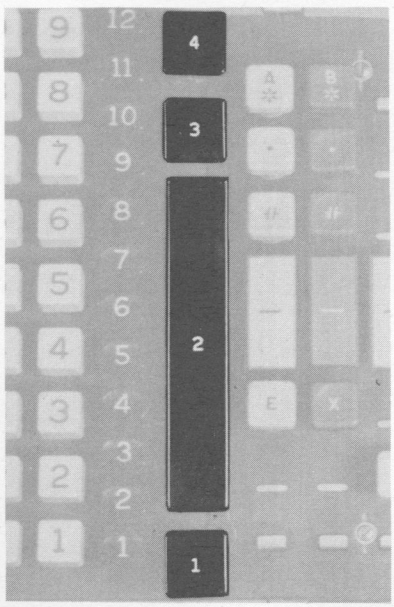


The E101 is now "on its own." It starts with the first instruction on pinboard 1 and follows each instruction in the pinboards in sequence. It performs each operation automatically until it comes to a KEYBOARD instruction in one of the pinboards. At that point, it stops, a gong rings, and the white KEYBOARD light (at the back of the control panel) lights up, indicating to the operator that it is time to enter a number into the keyboard. The operator can tell at a glance at what instruction the E101 has stopped by observing the neon lights on the control panel next to the START buttons. There is a light indicating pinboard number (1 to 8) and another indicating the step number in the pinboard (0 to 15). In the illustration at the right, above, the E101 has stopped for a keyboard entry at pinboard 1, step 4. The "Operating Instructions Sheet" on the next page shows what number is to be entered.



Notice that the first two items on line 1 are "K" and "Pinboard 1, Step 4," corresponding to the KEYBOARD light and Pinboard and Step lights on the E101. (It is always a good idea to check these to make sure you are in the right place.) Skipping across to the "Number" space, we see that the number to be entered is 63800000000. It is put into the 11-column keyboard the same as into an adding machine. To complete the operation, one of the four motor bars (to the right of the number) is touched. This does three things: puts the amount into the E101, prints it on the report, and moves the carriage to the next printing position. The position to which the carriage moves depends on which motor bar is touched.

Generally, motor bar 1 prints and returns the carriage to the left, motor bar 2 prints across the report horizontally, motor bar 3 prints in a vertical column, and motor bar 4 prints and skips to selected tab stops. These functions may be varied. They are set up in accordance with customer specifications. The programmer specifies which motor bar to use for each keyboard entry. The operator touches whatever motor bar is shown on the "Operating Instructions Sheet"—in this case, No. 3.



MOTOR BARS

OPERATING INSTRUCTIONS SHEET
ELECTRODATA 101

OPERATING INSTRUCTIONS SHEET

ElectroData 101

PROBLEM				PROGRAMMED BY	
Bonus Computation				P. Jones	
SET-UP	PINBOARDS	PRINTING SCHEDULE	SPECIAL INSTRUCTIONS		START BUTTON
	1 to 6	4			1

SIGNAL (K, H)	PINBOARD AND STEP		PINBOARD CHANGES, MANUAL INSTRUCTIONS, ETC.	START BUTTON	KEYBOARD ENTRY													MOTOR BAR
					X	Y	NUMBER											
K	1	4					6	3	8	0	0	0	0	0	0	0	0	3
K	2	7					0	0	3	9	5	4	0	0	0	0	0	2

ED-1278 1-57

As soon as the operator enters the number into the keyboard and touches one of the motor bars, the E101 continues automatically with the problem stopping at the next KEYBOARD instruction where the process is repeated.

Many problems are programmed so that all KEYBOARD instructions appear in one pinboard called the LOAD pinboard. Sometimes, a problem requires 8 regular pinboards plus a LOAD pinboard, in which case the LOAD pinboard and 7 of the 8 regular pinboards are inserted in the E101 until all keyboard entries have been made. Then the LOAD pinboard is replaced by the remaining regular pinboard. Whenever a change in pinboards such as this is necessary, there will be a notation on the "Operating Instructions Sheet."

After the last keyboard entry has been made, the E101 goes through the remaining steps in the problem, performing the necessary computations and printing out the final answers.

NOTE 1: In our example, the number to be entered into the keyboard is positive. If it were negative, there would be a minus sign following the number on the "Operating Instructions Sheet" and we would depress the minus bar on the extreme right of the keyboard before touching the motor bar. (See illustration on p. 2). Since the number is negative, it would print red.

NOTE 2: As an optional feature, input data can be entered into the E101 automatically by means of the E101 Tape Input Unit instead of being entered manually through the keyboard. Additional program instructions can also be punched into tape and fed into the E101 by means of the Tape Input Unit as a supplement to the pinboards. The write-up entitled "The E101 Tape Input Unit" includes a complete description of the Tape Input Unit.

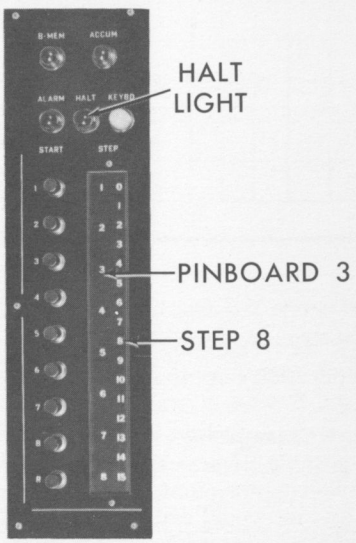
OPERATOR PARTICIPATION

Running the Problem

The type of problem we've been discussing is a typical automatic problem—with the E101 doing all the calculating drudgery and the operator entering the picture only to make an occasional keyboard entry. While many problems are of this nature, there are others that involve a greater degree of operator participation. The E101 has been specially designed so that computation can be stopped at any point to allow the operator to enter into the solution of the problem in those cases where it is advisable. This makes it feasible to run trial and error problems, and it allows scientists, engineers and other trained specialists, who are solving problems on the E101, to bring their experience and judgment to bear on the outcome.

On the next few pages we well discuss the HALT light, X and Y keys and other features of the E101 that enable the operator to play an important role in the solution of the problem.

First, the HALT light. This is a green light next to the white KEYBOARD light at the back of the control panel. It lights up and a gong rings when the E101 stops at a HALT instruction in one of the pinboards. Here again the operator can tell at what instruction the E101 has stopped by glancing at the neon pinboard and step lights on the control panel. The illustration below shows the E101 stopped at a HALT instruction at pinboard 3, step 8.



Just as in the case of a keyboard entry, the "Operating Instructions Sheet" tells the operator exactly what to do each time the E101 comes to a HALT instruction. It might call for the operator to insert a new report form in the printer, roll back the carriage, take a look at the answers that have been printed up to that point, change pinboards, etc. The third line in the illustration following shows a halt for a change in pinboards. In this particular problem we start out with a LOAD pinboard in pinboard position 1. When the E101 gets to pinboard 3, step 8, it stops for the operator to "replace the LOAD pinboard with pinboard No. 1." The signal "H" and pinboard step "3, 8" correspond to the lights on the control panel. In order to start the E101 operating again after the pinboard change, the operator depresses one of the START buttons—in this case No. 4.

SIGNAL (K, H)	PINBOARD AND STEP		PINBOARD CHANGES, MANUAL INSTRUCTIONS, ETC.	START BUTTON
K	1	4		
K	2	7		
H	3	8	Replace the Load pinboard with pinboard No. 1	4

Sometimes the "Operating Instructions Sheet" offers the operator a choice of START buttons. It might tell the operator to examine the printed results and proceed accordingly. If the answers at that point are all negative, for example, it might tell the operator to depress START button No. 8, which will take the E101 to the instructions on the last pinboard. If the answers are all positive, the "Operating Instructions Sheet" might instruct the operator to depress START button No. 1 which will take the E101 back to the beginning of the problem. If some of the answers are positive and some negative, it might specify START button "R" which is the REGULAR START button, green in color, located directly below START button no. 8. Whenever this button is depressed, the E101 continues with the problem where it left off instead of skipping ahead to another part of the problem or going back to an earlier part. As soon as the operator decides which part of the problem should be tackled next, he can immediately instruct the E101 to do so by touching the appropriate START button. This feature makes the E101 ideal for the solution of trial and error calculations.

THE X AND Y KEYS

The memory of the E101 consists of 100 memory locations, each one capable of storing a 12-digit number. As a matter of convenience the 100 memory locations have been assigned numbers (or addresses) beginning with 00, 01, 02, etc. and ending with 99. When a number that has been stored in the memory is needed in the solution of a problem, it is pulled out of the memory by an instruction in the pinboards that tells the E101 in which of the memory locations the number is stored. Ordinarily the process is entirely automatic. Sometimes, however, it is desirable for the operator to tell the E101 from which memory location to select the proper number. This is made possible by the X and Y keys which are the small dark keys in the first two columns on the left side of the keyboard. The operator indicates which memory location the E101 should use by depressing a key in the X column (at the extreme left) and one in the Y column. Memory

SIGNAL (K, H)	PINBOARD AND STEP		PINBOARD CHANGES, MANUAL INSTRUCTIONS, ETC.	START BUTTON	KEYBOARD ENTRY																MOTOR BAR
					X	Y	NUMBER														
K	4	12			6	7	5	2	8	0	6	3	0	0	0	0	0				4
H	5	3		6	8	4															

location 67, for example, would be indicated by depressing 6 in the X column and 7 in the Y column.

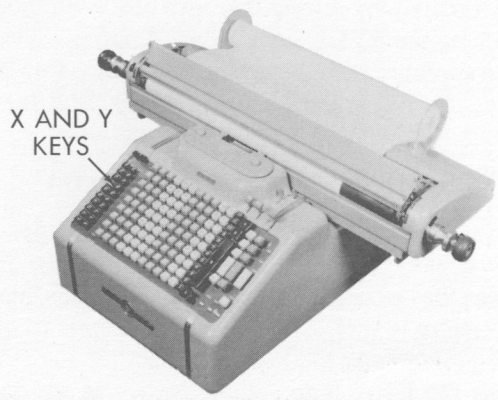
Just as in the case of keyboard entries and halts, it is the "Operating Instructions Sheet" that tells the operator *when* to depress the X and Y keys and *which ones* to depress. Frequently the instruction is given at the time of a keyboard entry. The example on line 1 above tells the operator to depress a 6 in the X column and a 7 in the Y column before entering the number into the keyboard and touching motor bar 4. Sometimes the "X, Y" instruction is given at a HALT. The example on line 2 above tells the operator to depress the X and Y keys corresponding to memory location 84 and then touch START button No. 6 to continue the problem.

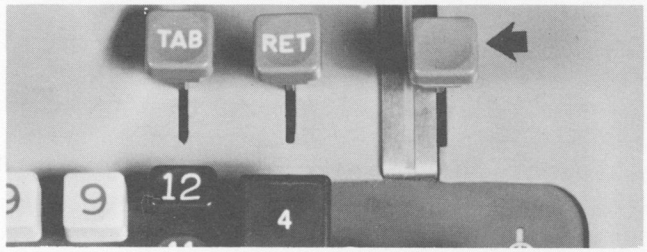
SPECIAL "SET-UP" INSTRUCTIONS

When we discussed the "Set-Up" instructions on the "Operating Instructions Sheet," we talked about the Pinboards, Printing Schedule and START button, but skipped over the block marked "Special Instructions." These instructions usually pertain to the printer and carriage and are similar to the directions we might give to a typist.

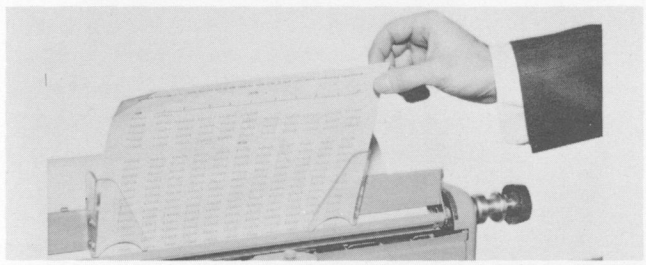
Front Feed

In the illustration below, the results are being printed on a continuous roll of plain white paper. Sometimes, it is preferable to print on individual report forms (ledger cards, collated form sets, duplicating masters, etc.). If so, the carriage will be equipped with an adjustable Form Holder and the programmer will specify the proper form in the "Special Instructions" block on the "Operating Instructions Sheet." To insert the form, the operator follows these simple instructions:





1. Depress the key at the back of the keyboard on the extreme right. This opens the carriage.



2. Insert the form in the carriage using the Form Holder as a guide. Form Guide Limits, set underneath the platen, can be used to stop the form at the proper line. The carriage will close automatically before the first print.

NOTE: If desired, the carriage can be set so that it will open automatically at a certain point in the problem.

Vertical Spacing

The E101 prints six lines to an inch just like a typewriter. It can be set to non-space or space up to 6 lines at a time. To change from one type of spacing to another, the "Space" lever on the right side of the carriage is moved to the proper setting while the carriage is closed—the same as on a typewriter. Generally, reports are single spaced unless the programmer specifies double, triple, etc., in the "Special Instructions" block on the "Operating Instructions Sheet."

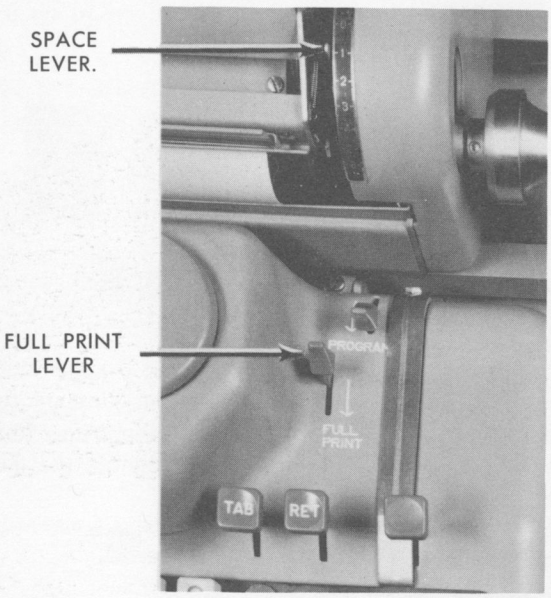
Zero Suppression

Sometimes the instruction "Suppress Zeros" appears in the "Special Instructions" block on the "Operating Instructions Sheet." This means to move the FULL PRINT lever to the rear position. When the lever is in the forward or FULL PRINT position (toward the operator) results are printed in full including all zeros (for example: 000008460372). When the lever is in the rear position, the zeros on the left are suppressed (for example: 8460372).

Tab and Return Keys

The two keys in front of the FULL PRINT lever enable the operator to move the carriage manually. The TAB key moves the carriage to selected tab stops the same as on a typewriter while the RETURN key returns the carriage. Ordinarily the carriage is at the right at the beginning of a problem so that the first printing takes place in column 1. Sometimes, however, the programmer will have a note in the "Special Instructions" block on the "Operating Instructions Sheet" to move the carriage to column 2, 3, etc. before starting the problem. Another time these keys are used is in changing from one printing schedule to another, as described on page 1.

NOTE: The PROGRAM lever directly behind the FULL PRINT lever should be in the forward position (toward the operator) before starting a problem.

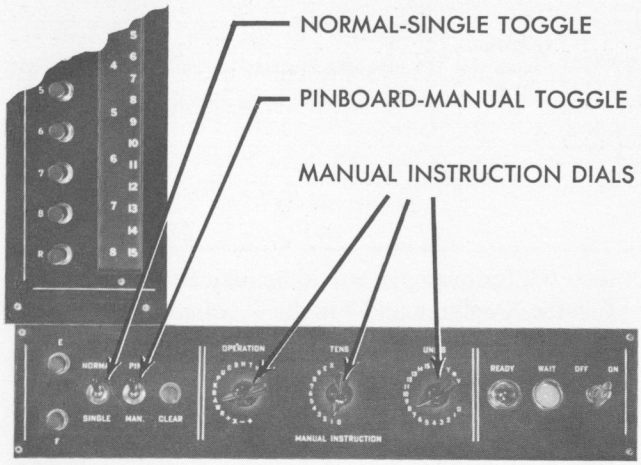


MANUAL OPERATION

Checking out or "debugging" a program on electronic computers has always been a long tedious job for the programmer. When the ELECTRODATA 101 was designed, special features were built into the machine to make this job as simple as possible. The two toggle switches at the left of the control panel enable the programmer to run through a program one step at a time, or to operate completely manually when desired. With the proper use of these switches, checking out a program on the E101 is usually only a matter of minutes.

"Single Step" Operation

Normally, the E101 goes through all the instructions in the pinboards in sequence without stopping—except for keyboard entries and halts. Sometimes (especially when checking out a program) it is helpful to execute a single pinboard instruction at a time, stopping after each instruction before going on to the next. We call this "Single Step" operation as opposed to "Normal" operation.



When a programmer wishes to use "Single Step" operation, he moves the toggle switch at the left of the control panel from the NORMAL to the SINGLE position. Then he touches the green REGULAR START button which executes a single instruction in the pinboards. To execute the next instruction, he must again touch the REGULAR START button. The process is continued until he throws the E101 back into "Normal Operation" by returning the switch to its NORMAL position.

Manual Instructions

Sometimes, when running a problem on the E101 (frequently when using "Single Step" operation), it is desirable to perform certain operations that have not been pinned up in the pinboards. For example, a programmer might be checking out a program and decide that he would like to print out more information than he originally allowed for in his pinboard program. He can print out the additional data *without disturbing the pinboards* by throwing the E101 out of pinboard control and into manual control.

To do this, he moves the right-hand toggle switch at the left of the control panel from the pinboard (PIN) position to the manual (MAN) position. Then he sets the three MANUAL INSTRUCTION dials in the center of the control panel to correspond to the print instruction and touches the REGULAR START button. While the E101 is in manual control, he can perform any operation he desires merely by setting that instruction on the dials and touching the REGULAR START button. When he wishes to continue with the instructions pinned up in the pinboards, he moves the toggle switch back to the PIN position.

PINNING-UP THE PINBOARDS

Back on page 1, we described how the pinboards, with the pins already in place, are inserted into the E101. Sometimes the operator is asked to drop the pins in place. The procedure is very simple. The first step is to obtain from the programmer the Program Sheet showing the instructions the E101 is to follow. Notice in the sample

below that there is room for 16 steps on each pinboard (numbered 0 through 15). Each step is a separate instruction. For example, the first instruction, K, tells the E101 to stop for a keyboard entry while the second instruction, W 9 6, means write the number into memory location 96.

ElectroData
101
Program Sheet

PB 1

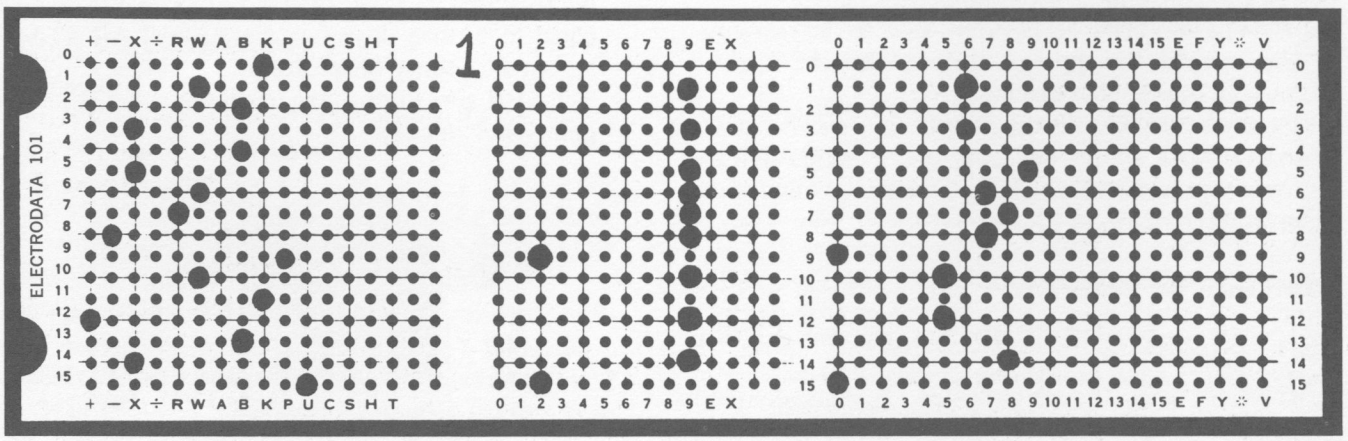
0	K
1	W 9 6
2	B
3	x 9 6
4	B
5	x 9 9
6	W 9 7
7	R 9 8
8	- 9 7
9	P 2 0
10	W 9 5
11	K
12	+ 9 5
13	B
14	x 9 8
15	U 2 0

TEMPLATE

Once the Program Sheet is in hand, the next step is to mark the proper pin positions on pre-punched paper templates that fit over the pinboards. (The eraser end of a pencil inked on a stamp pad does the job nicely.) The sample template below has been stamped to agree with the Program Sheet above.

Notice that there are 16 horizontal rows of holes on the template corresponding to the 16 instructions on the Program Sheet. Each row is stamped to represent the corresponding instruction on the Program Sheet.

After the templates are stamped, they are laid over the pinboards and the pins dropped in the indicated holes.



THE ALARM LIGHT

There are conditions under which the E101 stops, rings a gong and lights the red ALARM light next to the HALT light. In case of an ALARM, the operator should:

1. Check to see if either of the amber lights behind the ALARM light is on. If so, notify your supervisor.
2. Examine the pinboards to make sure the pins have been dropped in the proper holes. ALARMS caused by improper pinning can be from two sources; mis-pinnings or double pinnings. In mis-pinnings, a pin has been incorrectly placed in one of the areas of a pinboard instruction. The instruction is executed but, it is not the instruction intended by the programmer. A double pinning occurs when two pins have been placed in the same pinboard area of a particular instruction. The corrective measures for mis-pinnings and double pinnings are discussed on pages 21-22 of the *Handbook Advanced Programming* in the sections on *Checking Circuitry* and *Programming and Operating Errors*.
3. Compare the Program Sheets with the templates to make sure the templates are properly marked.
4. Check the keyboard entries printed on the report against the numbers on the "Operating Instructions Sheet" to make sure they are correct. If none of these steps helps locate the trouble, notify your supervisor.

NOTE: Occasionally an operator has trouble in running a problem because the pinboards are not in the proper positions. Make sure they are in the same order as the pinboard lights, with pinboard No. 1 all the way back.

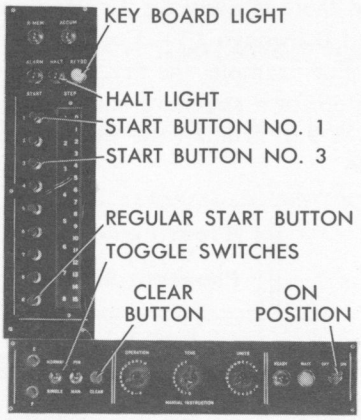
EXPLANATION OF THE SAMPLE PROBLEM ON THE OPPOSITE PAGE

Setting up the Problem

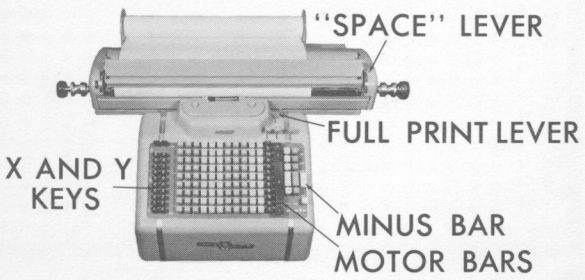
1. In setting up the problem on the opposite page, the first thing the operator does is turn the computer "on"; after the READY light comes on, he depresses the CLEAR button.
2. Then he inserts the 8 pinboards into the pinboard section with pinboard 1 all the way at the back.
3. Next he moves the carriage all the way to the left or right and turns the schedule knob to schedule 4.
4. Then he moves the "Full Print" lever to the rear position in order to suppress zeros and sets the "Space" lever at 2 for double spacing.
5. Finally he checks to make sure the toggle switches are in NORMAL and PIN position, the "Program" lever is forward, and the carriage is in column 1 ready for the problem to begin.

Running the Problem

1. To start the problem the operator depresses START button No. 1.
2. The E101 goes through each step automatically until it reaches pinboard 1, step 10, where it stops for a keyboard entry. The operator checks the lights on the control panel against the signal and pinboard and step numbers shown on line 1 and enters the first number 648 into the keyboard, touching motor bar 3 to complete the operation.



3. The E101 stops again at pinboard 2, step 6. This time the operator enters 3057 into the keyboard, depresses the minus bar at the extreme right and again touches motor bar 3.
4. The next time the E101 stops is at pinboard 2, step 12, where the operator enters the number 483 and once again touches motor bar 3.
5. Line 4 shows a halt at pinboard 2, step 14. Just as in the case of keyboard entries, the operator checks the lights against the information shown on the "Operating Instructions Sheet." Then he rolls the carriage back to line 1 and depresses START button No. 3 to continue the problem.
6. The E101 continues automatically until pinboard 3, step 6, where it stops for another keyboard entry. This time the operator depresses an 8 in the X column and a 4 in the Y column, enters 4280000, into the keyboard and touches motor bar 2.
7. Line 6 shows another keyboard entry with a different setting for X and Y. The operator depresses a 7 in the X column and a 2 in the Y column, enters 94 into the keyboard and again touches motor bar 2.
8. The last instruction is another halt, this time at pinboard 4, step 8. The operator sets X equal to 6 and Y equal to 5, then depresses the REGULAR START button to continue the problem.
9. The E101 goes through the remaining steps in the program automatically.



OPERATING INSTRUCTIONS SHEET

OPERATING INSTRUCTIONS SHEET

ElectroData 101

PROBLEM	Oil Check	PROGRAMMED BY	R. Boynton

SET-UP	PINBOARDS	PRINTING SCHEDULE	SPECIAL INSTRUCTIONS	START BUTTON
	1 to 8	4	Suppress zeros, Double space	1

SIGNAL (K, H)	PINBOARD AND STEP		PINBOARD CHANGES, MANUAL INSTRUCTIONS, ETC.	START BUTTON	KEYBOARD ENTRY														MOTOR BAR
					X	Y	NUMBER												
1) K	1	10					0	0	0	0	0	0	0	0	6	4	8		3
2) K	2	6					0	0	0	0	0	0	0	3	0	5	7	-	3
3) K	2	12					0	0	0	0	0	0	0	0	4	8	3		3
4) H	2	14	Roll carriage back to line 1	3															
5) K	3	6			8	4	0	0	0	0	4	2	8	0	0	0	0		2
6) K	3	13			7	2	0	0	0	0	0	0	0	0	0	9	4		2
7) H	4	8		R	6	5													

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E101 OPERATING CHECK LIST

Setting up a Problem

A. Things to do

1. Turn computer "on," (Wait for READY light.)
2. Depress CLEAR button.
3. Insert pinboards.
4. Turn schedule knob to proper schedule. (Make sure carriage is all the way to the left or right.)

B. Things to check

1. Are toggle switches in NORMAL and PIN positions?
2. Is PROGRAM lever forward (toward operator)?
3. Is FULL PRINT lever forward (unless zero suppression is called for)?
4. Is carriage in column 1 (unless some other position is specified)?
5. Is "Space" lever set for single spacing (unless double, triple, etc. is called for)?
6. If special form is specified, has it been inserted in carriage?

Running the Problem

A. Things to do

1. Depress proper START button.
2. Follow instructions on E101 Operating Instructions Sheet.

B. Things to check when E101 stops for a keyboard entry or at a HALT.

1. Do lights on control panel correspond to signal and pinboard step numbers shown on "Operating Instructions Sheet"?
2. In case of a keyboard entry, is number plus or minus?
3. Are X and Y settings called for?

ElectroData
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