Automatic Translation of Printed Code to Impulses Acceptable to Computing Equipment

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MR. CHAIRMAN. . . . Ladies and Gentlemen: It is a pleasure for Mr. Fortune and me to be allowed to make this presentation on "Automatic Translation of Printed Code to Impulses Acceptable to Computing Equipment."

It is probable that the best way to cover this subject is to describe a machine system known as the Stanomatic. This name Stanomatic is derived from the words *S*ymbol *T*ranslator *A*utomatically e*N*ergizing *O*ffice *M*achinery. We at The Standard Register Company saw no reason to depart from convention, but we will have to admit that we had a little difficulty finding the words to create a name. It was an effort, but we managed. Accidentally, of course, the name does have some significance when you consider that the Engineering and Research Division of The Standard Register Company developed this device.

Many of you may be wondering why The Standard Register company, with its more than 40 years of manufacturing business forms and feeding devices, has entered into this particular field. A short explanation is in order at this time, without violating the spirit of this conference and its scientific aspect.

We are manufacturers of continuous business forms and feeding devices for application to any type of business machine, such as typewriters, tabulators, etc. Our feeding devices are based on the principle of the pinwheel or sprocket feed. Our forms all carry holes down the sides, which we call Kant-Slip holes, and when these forms are fed into any type of business machine, the holes down the sides of the paper and the pinwheels or sprockets in the machine feed, align, and register these forms automatically and accurately.

We manufacture and carry as stock items some 750 types of pinwheel feed devices, each of them designed to fit the architecture of the machine on which they are installed. We manufacture special auxiliary equipment such as carbon separators, bursters, imprinters, etc. We send out of our plant two to three special devices a day, either adaptations of the standard pinfeed mechanisms or entirely new devices which, up until that time, have not been in existence. We manufacture thousands of autographic registers, the kind of machine you see on the hardware counter, in the jewelry store, florist shops, etc. We do not manufacture tabulators, typewriters, adding machines, bookkeeping machines, or similar types of equipment.

We have for years expounded on the subject of paperwork simplification, and, at times, in trying to carry the gospel of paperwork simplification to business people, we have felt that we were carrying the lone torch in a mass of darkness. Only recently have the businessmen of America begun to realize the intolerable burden of paper handling, and you people making up this conference have attempted to answer this need. Shuffling of papers, the recording and re-recording of information, have become such a burden that (as I believe you all know) there are more people employed in offices today than there are on farms.

We have always liked to feel that we are in a position similar to that of the Process Engineer in the manufacturing plant, except that we confine our efforts to process engineering in the office, attempting to streamline production, so that the end product has been completed as accurately and as quickly as possible with a minimum amount of manual effort. Our nationwide Sales Analysts and Service Departments have made thousands of recommendations for improvement of paper handling, elimination of repeated record making, and, of course, continuous forms and feeding devices for all types of business machines have eliminated the paper handling problem at the machine. Leaving the development, manufacture, and sale of computers and other office equipment in the very capable hands of those persons who are now working on such developments, The Standard Register Company will continue in the field of being the process engineers to American business, attempting to provide the auxiliary equipment and supplies for the input and output of these machines where conventional documents are still going to be necessary.

To those of us who have been associated with office procedures for years and to those who have only recently entered the field, it is a self-evident fact that one of the major problems involved in machine bookkeeping, whether it be mechanical or electrical, is the problem of getting the recording of the original transaction, whether it be retail or another type of transaction, into such shape or form that machines can recognize the recording and use it for the purpose of computation and accounting. The time-honored method of a human being using the eyes and brain to recognize printed material and transferring this information by means of fingers to keys in bookkeeping machines, typewriters, or key punches, will continue to be used, particularly where the volume is not too large. If the preparation of the original document of a transaction automatically created an auxiliary recording in addition to the conventional

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recording of the transaction, which could later be used to eliminate the human being translating the conventional writing on the document to keys on a keyboard, and the document could be used directly by a machine to create an accounting record, I believe we would have contributed considerably to automation in the office.

All of us here are familiar with the attempts to produce the ideal, such as the recognition of conventional characters and their translation to electrical impulses, and many others. We do not wish in any way to discredit the very excellent work which has been done in this field. However, Stanomatic, with its simple coding, can be used now in the everyday business world. The Stanomatic (Fig. 1) was developed to accept, and is

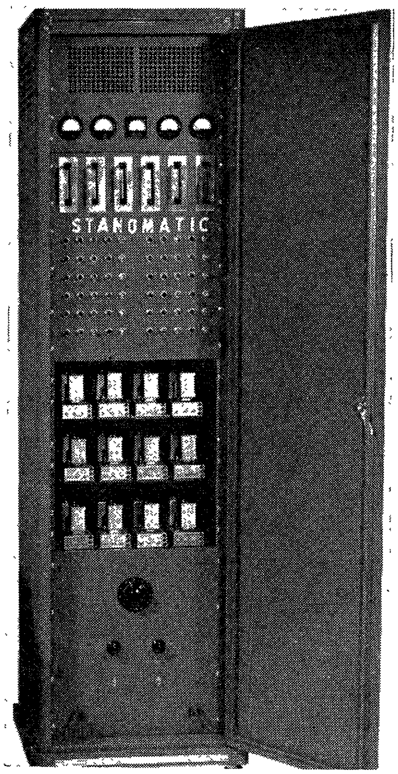

Fig. 1—Stanomatic control cabinet with sensing circuits, control circuits and memory.

capable of automatically accepting, coded information from handwritten or machine-written source documents and translating this information into recognizable business machine code to operate punched card equipment, computer input equipment, etc. From the time the source document is created until the final report is made, there is no need for manual translation from the written word.

In order to better understand the application of Stanomatic to any given system, a greater understanding of the potential of this device will prove helpful. To this end a description of the unit and the basic principles involved is essential.

The Stanomatic senses and translates printed coded information from business forms at a speed of 500 forms per minute. The output of the Stanomatic can be fed either directly into high-speed data-handling equipment or through memory circuits to conventional or slow-speed handling machines. The Stanomatic operates from coded information preprinted with special ink, ribbon, or encoded from special carbon capable of upsetting a sensitive balanced electronic circuit. This coded information, in the form of dots printed on source documents (Fig. 2), is arranged in 30 columns of 5 dot

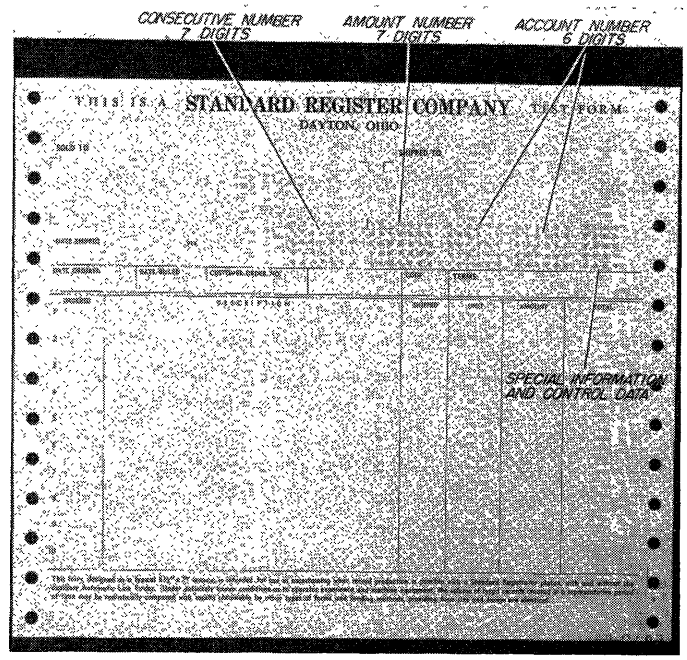

Fig. 2—Form with imprinted code. The code dots may be arranged in any grouping on either the front or back of the form.

locations per column, consisting of 150 bits of information. A single digit in this code occupies one column and its value is determined by the location of two dots printed on a given column. The coded dots release parallel pulses through a predetermined sequence of operations and a signal is fed into data-handling machines as decimal digits. The output can be in any numbering system, binary or similar codes used in electronic computers, 5-, 6-, 7-, and 9-channel punched tape code, or any machine code, by the use of suitable conversion units.

Coding

Stanomatic makes use of 150 bits (printed dots) equivalent to 30 decimal digits per form, which may be used in any combination to provide decimal digits and separate control groups. Each dot represents essentially a binary digit or bit, and the numbers 0 through 9 are shown in the chart (Fig. 3) below with their associated codes. Each printed dot is approximately 1/16 inch in diameter and is separated from any adjacent dot by 1/16 inch. Dots in two of five dot locations in a vertical column are used to represent each decimal digit. The first dot in any column is assigned the value 1; the second, 2; the third, 4; the fourth, 7; and the last provides a self-checking feature. Each digit is composed of two dots so that the translation of their numerical designation is made in self-checking circuits.

DIGIT NO	1 2 4 7 X ○ ○ ○ ○ ○
1	● ○ ○ ○ ●
2	○ ● ○ ○ ●
3	● ● ○ ○ ○
4	○ ○ ● ○ ●
5	● ○ ● ○ ○
6	○ ● ● ○ ○
7	○ ○ ○ ● ●
8	● ○ ○ ● ○
9	○ ● ○ ● ○
0	○ ○ ● ● ○

Fig. 3—Stanomatic code. This is a self-checking code utilizing two code dots for each digit.

The Stanomatic Sensor

At any time after the coding is completed on the forms, they may be inserted into the Stanomatic Sensor. The forms may be fed through the feeder in a continuous strip or as individually cut forms. Fig. 4 shows one

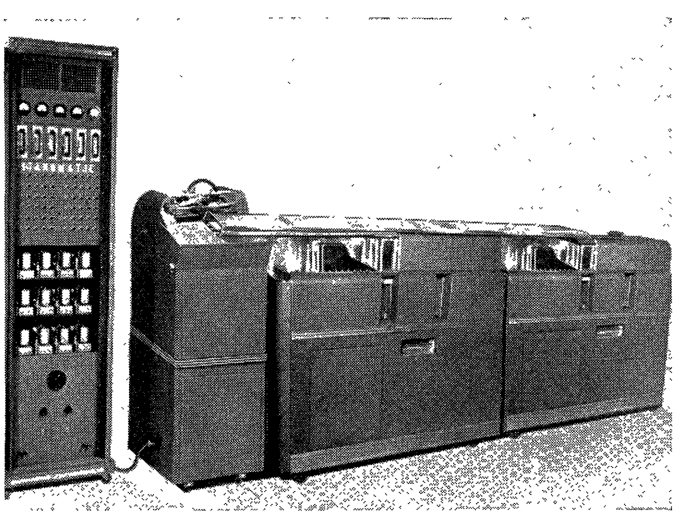

Fig. 4—Stanomatic with two reproducing punches. Operating at maximum speed, the Stanomatic has the capacity to operate five reproducing punches.

variation of Stanomatic equipment where the output from the Stanomatic is used to operate two reproducing punches for the creation of punched card records. The principle of sensing or reading the coded information is the same whether the forms are fed in a continuous strip or individually. As the form is fed, the coded area passes over a sensing head.

The presence of a Stanomatic spot in any given area triggers a balanced electronic circuit (Fig. 5) and the impulses thus created by the sensing units are used to actuate the buffer storage unit in accordance with the code on the source document. Internally, all information is fed in parallel throughout the equipment. At the instant the information is received in the buffer storage, a control pulse is fed through a circuit in the buffer storage unit. This circuit is made by the combined action of the entire code.

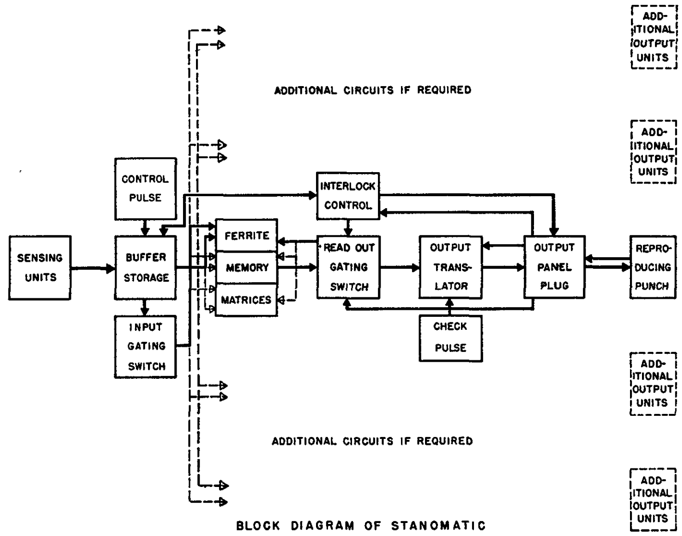

Fig. 5—Schematic diagram of Stanomatic circuit.

In the case where all coded information has been properly read and stored in the buffer memory, the control pulse stores the sensed information into a ferrite memory matrix. The same pulse operates the input gating switch to shift the input circuit to the memory matrix at the next memory plane. This same pulse also triggers an interlock control circuit to actuate a reproducing punch. The final action of the control pulse restores the buffer storage for the next sensing operation. The control pulse, to explain further, is coincident with a pulse of equal magnitude synchronously timed with the operation of the feeding equipment, and storage occurs in the normal manner for ferrite memories. The form just sensed would then be transported to a receiving hopper. In the case of a form being sensed with incomplete information, the control pulse is blocked so that it does not trigger the memory matrix, the input gating switch, and the interlock controls, but triggers and restores the buffer storage unit for the next sensing operation and actuates a reject gate causing the form to be placed in a reject hopper. This feature assures that all information sensed is correct, and that this information will be accurate when received by the terminal equipment, such as the reproducing punch. Rejected forms can be processed by hand, and experience shows the percentage of rejects to be very low.

Associated interlocking controls to properly time and synchronize the operation of the reproducing punch are set up at the time the information is verified by the control pulse. These interlocking controls cause the information stored in the memory to be made available when the read-out gating switch is activated. This switch, in turn, is controlled by the reproducing punch. At the start of operation, the reproducing punch (ready to operate) initiates a read-out pulse immediately after the read-in pulse to the ferrite plane. This information is placed in the output translator and the translator circuits make the information acceptable in decimal form to be punched into a standard tab card. When the first card-cycle of the reproducing punch is completed, the information stored in the translator is erased, the output gating switch reads information from the next into the translator, and the cycle repeats. As information is placed in the translator a control pulse insures that all information originally sensed is still present. If the information is not complete, both the feeder and the reproducing punch stop, indicating trouble. The interlocking system controls a clutch on the source document feeder when all ferrite planes are filled for a given reproducing punch. The feeder will skip feed cycles until an open memory is made available. Necessary circuits to stop both machines in case of jams, misfeeding, etc., are incorporated in the interlocking controls.

Document Originating Machine

Creation of the source documents in the Stanomatic code is accomplished as an automatic by-product of all operations performed on that document from the time it is printed until the document has been completed by the addition of either handwritten or machine-written data. The printing facilities of The Standard Register Company are available for including code imprinting in the Stanomatic ink for serial numbers and other permanent figures at the time forms are printed. If the originating document is to be handwritten, a model of an autographic register (Fig. 6) is available for handling

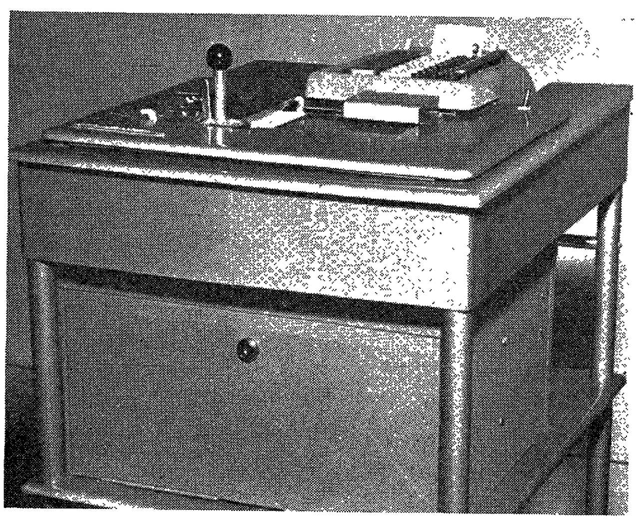

Fig. 6—Imprinting Register. Code impressions are obtained from permanent imprint unit (left) and from keyboard at the top.

marginally punched continuous forms, and for imprinting, in code such information as will be needed to complete the business transaction. This information may consist of the account number of the customer, the branch from which the order originated, the cash amount of the merchandise order, and the specific items required by this customer. Data may be encoded by depressing keys on a keyboard similar to those used on an adding machine. Constant data, such as a branch office, area, or register number, is imprinted from a code slug. In addition, personal account numbers can be obtained by code embossed on credit cards carried by the customer. In instances where there are many points of origin of source documents, a portable unit, Fig. 7, incorporating simplified coding features is available.

Fig. 7—Portable imprinting register. Code is indicated by depressing keys and the imprint is obtained by depression of the lever.

Two basic units are also available for imprinting codes reflecting machine-written information, depending on the type of form used. On a typewriter or a bookkeeping machine feeding marginally punched continuous forms, the code-imprinting heads mount in a unit directly behind the machine, as shown in Fig. 8, and the

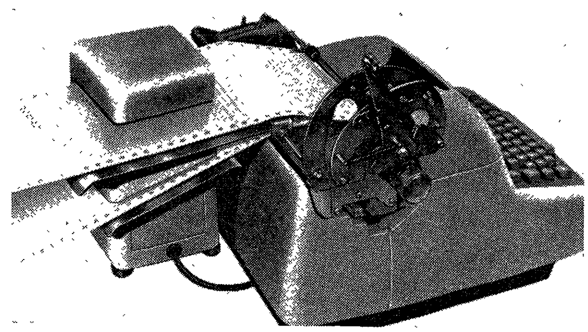

Fig. 8—Imprint unit for continuous form. Imprint is obtained from unit in back of typewriter or bookkeeper, actuated by depression of Line Finder lever on carriage.

individual code wheels index from an electromechanical transfer medium connecting the numerical keys on the typewriter or bookkeeping machine to the code-wheel mechanism. The actual imprinting of the code occurs after a form is ejected from the typewriter or bookkeeping machine. As a result, preselected information to be encoded stores in a buffer memory until a form is ejected. The form is ejected by means of an Automatic Line Finder, which also signals the code imprint unit to print from its memory onto the form. Proper registration in this instance is assured by the pinfeed of the continuous forms.

When individual forms are processed over a machine, the coding mechanism, while similar in design to that above, is not mounted directly behind the carriage, but consists of a separate unit which rests on the typewriter or bookkeeping machine stand, as shown in Fig. 9. The code data are set up in the manner prescribed above and the imprinting is accomplished by inserting the com-

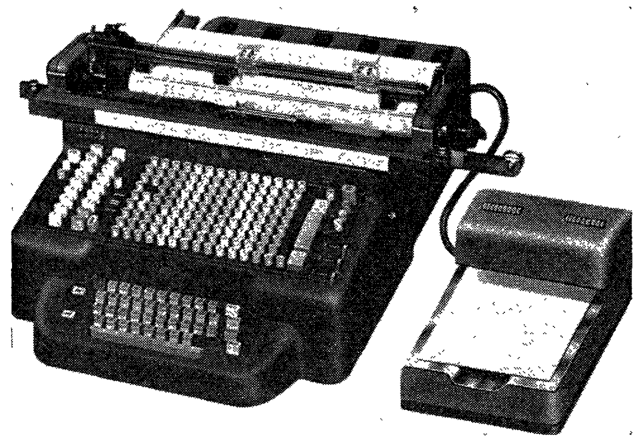

Fig. 9—Code unit for unit zipsets. Carbon interleaved unit zipsets may be inserted in coder to receive impressions.

pleted form into the code unit. The form, when inserted, trips a registration control circuit and the codes are imprinted. Proper registration and alignment are assured by the use of form guides and the code registration circuit. While it is necessary that the code spots be located in relationship to two edges of the source document so that the sensor can interpret data correctly, code can appear at any predetermined position on the form. It need not be in the same order as the typed information, nor must it be located in the same area. If the form receives a great deal of typing, the code could appear on the back of the form, or it could appear in the preprinted heading area of the internal copy, since normal printing ink has no capacity for being sensed. As long as the area imprinted is constant, the coding can appear wherever the customer desires. Code data in excess of 30 digits is encoded on a form in successive groups of 30 digits by advancing the form in the coding machine a suitable distance to give an effect of line-at-a-time printing, and a similar arrangement is provided in the reader and sensor.

Figure 10 brings together the Stanomatic receiving information from a business form encoded by one or more of the input machines mentioned earlier and, in addition, shows the output of Stanomatic flowing to various forms of accounting and computing machines or auxiliary equipment. We have here a small demonstration unit and will move a piece of paper in the sensing zone. This paper has printed on it a dot in sensible ink. When the dot is in position, a light will light, indicating the dot has been sensed. If, in developing the Stanomatic, the auxiliary equipment such as coding registers and other coding means—the inks, carbons, and ribbons—we have contributed to the more ready acceptance of new business equipment and helped to eliminate the laborious and expensive manual transcription of conventional symbols to ones recognized by machines, we will feel that the time and labor have been well expended.

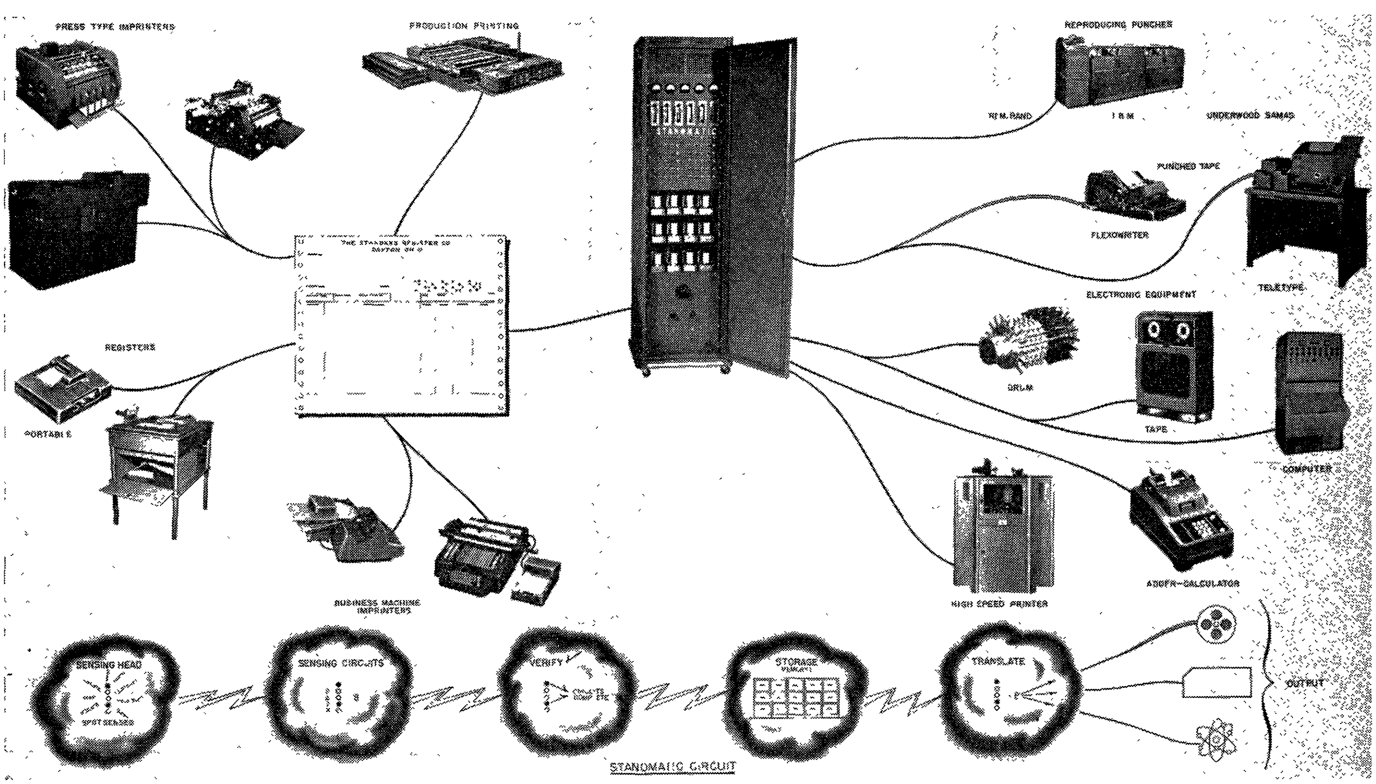

Fig. 10—Stanomatic input, output chart. Code impressions received from the units shown at left may be processed through Stanomatic and interpreted to any code used by the output units shown at the right.