

ELECTRONIC

calculators

Electronic Calculators

Report

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Friden, *International P.A.*

Prepared by
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INTRODUCTION

Possibly most significant in the evolution of mechanical calculators was the introduction in 1642, of 'toothed wheels' by Blaise Pascal.

Three centuries later, FRIDEN Inc. introduced to the market the first American electronic desk calculator. Actually there are now more than twenty-five companies, who manufacture electronic desk calculators.

This report is intended to classify all the different types of electronic calculators marketed in the world.

The basic aspects of all the electronic desk calculators have been covered in this survey. However, it should be borne in mind that the construction, operation, and prices of such equipment may change from time to time. All information contained within this report regarding equipment of other companies was obtained from sources believed to be reliable.

The following companies also have announced that they will bring onto the market an electronic desk calculator.

- Rheinmetall Eastern Germany
- Diehl Germany
- Settematic U.S.A.
- Electrosolids U.S.A.
- Nisj Mika Alas Yugoslavia
- Sony MV-O Japan
- Elka Bulgaria

As more information concerning these units is made available, subsequent reports will be published.

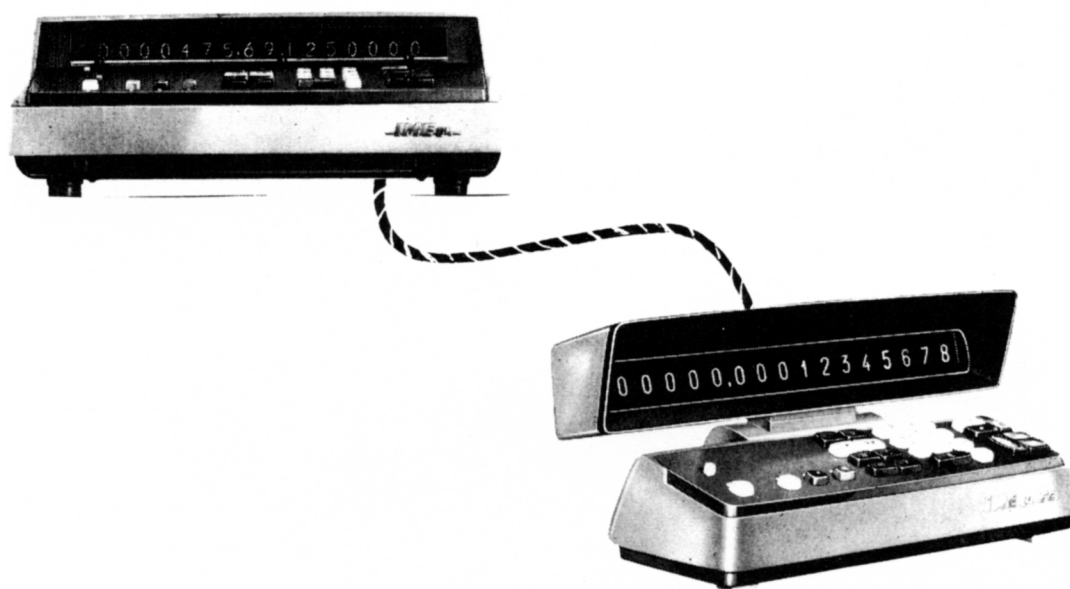
Many people have assisted in preparing this report. We are indebted to all of them. Particular thanks go to the Product Planning Dept. of San Leandro and Nijmegen, the Sales Promotion Dept. of Rochester and Friden International, District III for the information they have given.

Electronic Calculators

IME 84 RC

The IME 84 has already been completely described in a former comparison with our Friden 130, issued by the International Education Centre at Berg en Dal.

A new development of the Industria Macchine Elettroniche S.p.A. in Rome is the IME RC, which is an electronic desk calculator with Remote Control. Up to four remote keyboards can be connected to each machine.



The connection is done by means of a special cable. If more than one keyboard has to be connected, a distribution box is required. IME makes great fanfare with this system, but it is very doubtful if it will prove to be successful in future.

MARCHANT COGITO 240

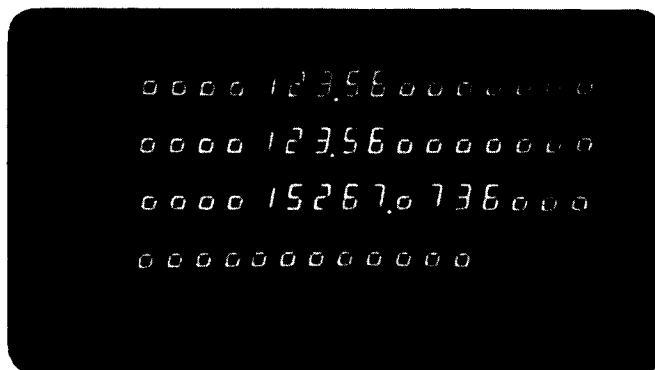


EXPLANATION OF REGISTERS AND KEYBOARD

The K register consists of 16 zero digits. The first four zeros can only be used as zero digits in a decimal number. Consequently, a whole number would start in the fifth digit position from the left. A decimal entry, with several zeros immediately after the decimal point, causes the decimal point to incorporate the first four zero digits. If more than four digits follow the decimal point in a decimal entry, the decimal will appear on the right side of the Q register. The following examples will illustrate these possibilities.

3419689	K 0 0 0 0 3 4 1 9 6 8 9 . 0 0 0 0 0
.03	K 0 0 0 . 0 3 0 0 0 0 0 0 0 0 0 0 0 0
.0003	K 0 . 0 0 0 0 3 0 0 0 0 0 0 0 0 0 0 0
.0000003	K 0 0 0 0 3 0 0 0 0 0 0 0 0 0 0 0 0
	Q 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 . 0 0
34.26	K 0 0 0 0 3 4 . 2 6 0 0 0 0 0 0 0 0 0

The Q register is used to show either quotients or multipliers. Again, the first four digit positions on the left of this 16 digit register are used as zeros in a decimal quotient or multiplier.



The P register is a combination of the bottom two columns of zeros. The second from the bottom register has 16 zero digits. The first four zero digits are used only as zero digits in decimal answers in the same manner as described for the K register. The bottom register has 12 zero digits with four blank spaces on the right. The total of these two registers provides a combination of 24 usable digits for a product.

A 24 digit product would be read from the fifth left digit position in the second column from the bottom to the right. The number continues with the last 12 digits in the bottom column from the extreme left position to the right. The following examples will illustrate this procedure: 123456789.012345678901234 and .00012345678901234567890 appears as:

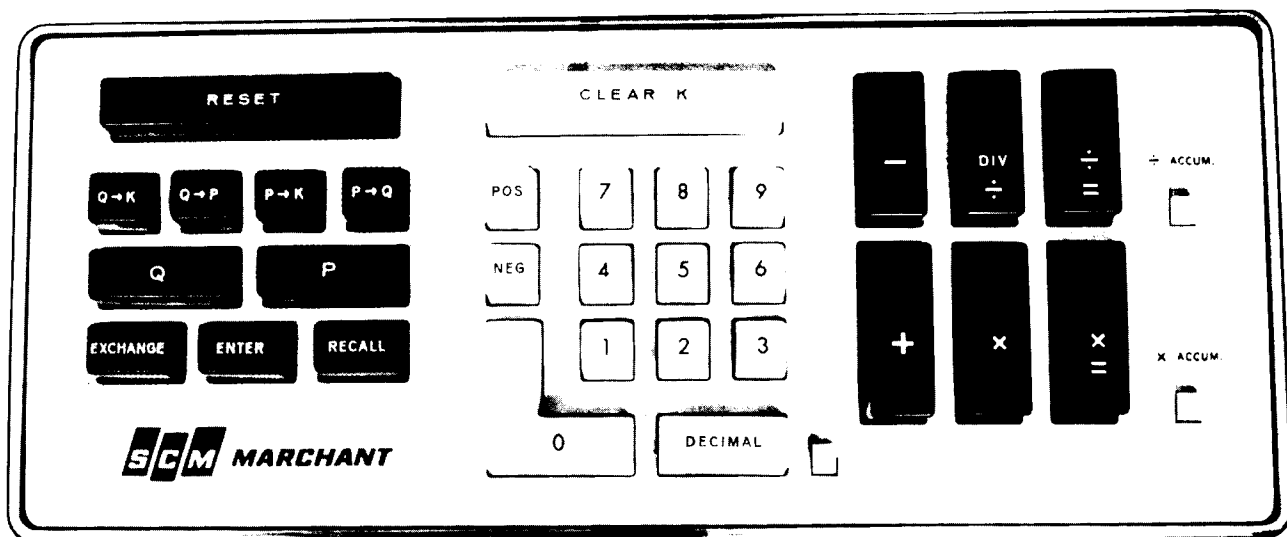
```
0 0 0 0 1 2 3 4 5 6 7 8 9 . 0 1 2
3 4 5 6 7 8 9 0 1 2 3 4
```

```
0 . 0 0 0 1 2 3 4 5 6 7 8 9 0 1 2
3 4 5 6 7 8 9 0 0 0 0 0 0
```

The P register is also used for the dividend in a division problem, and answers to addition and subtraction problems.

Corresponding to the visible K, Q and P registers are invisible or storage registers K, Q and P. These storage registers have the same capacities and will store any number in its equivalent visible register. What is in the visible Q register can be stored in the invisible Q storage register.

The stacking principle incorporated on the 130 should not be confused with the register configuration or operation on the COGITO 240. There is very little relationship. Movement between registers on the COGITO must be actuated by the depression of a function key. Numbers do not necessarily move from the keyboard register down in sequence. When a dividend is indexed on the keyboard, it appears in the K register. When the DIV + key is depressed, the dividend moves from the KK register to the P register. Another difference is that zeros are about half the size of all other digit entries.



An eleven key keyboard is used for input of all numbers. It includes a decimal point key and an L-shaped zero bar similar to the zero bar on the AFY adding machine. The decimal point key is used whenever a decimal point appears in a number. It is not used for whole numbers.

The POS and NEG keys have the same function as the CHANGE SIGN key on the 130. All numbers indexed on the keyboard are positive. When entering a negative number, the NEG key must be depressed after the number is indexed on the keyboard. To change a negative number in the Q or P register to positive, it must be transferred to the K register. After the number has been transferred to the K register merely depressing the POS key changes the number from negative to positive.

The CLEAR K key above the keyboard is used to clear an incorrect entry in the K register without disturbing any of the other registers. The CLEAR K key has the same function as the CLEAR ENTRY key on the 130.

FUNCTION KEYS

The Minus (-) and Plus (+) keys are self-explanatory.

The DIV \div key is used for the first factor in a division problem. When depressed, it causes the number indexed in the keyboard and appearing in the K register, to move from the K register to the P register. The P register shows the dividend in a division problem, as well as products in multiplication problems.

The $\div =$ key is used after the second factor in a division problem is indexed in the keyboard and appears in the keyboard register. When the $\div =$ key is depressed, the divisor in the K register divides into the dividend in the P register; the quotient to the problem appears in the Q register.

When the dividend moves from the K register to the P register, the decimal point position is retained or is identical to its position when the number was in the K register. The decimal in the divisor is also indicated at the time the decimal point key is depressed when the divisor is indexed in the keyboard. The divisor appears simultaneously in the K register as it is being indexed. Consequently, visual proof of both factors, with decimal points, is accomplished prior to the initiation of the actual operation of $\div =$ key.

The \div ACCUM switch, when moved up, allows automatic accumulation of quotients. This does not provide for individual quotients however, but rather an accumulated subtotal at the completion of each problem. It is assumed that the switch must be moved to the off position at the end of the problem.

The X key is used for the first factor in a multiplication problem. When the multiplier is indexed in the keyboard, it appears in the K register. Depressing the X key causes the first factor (the multiplier) to transfer to the Q register. The decimal position remains the same when the multiplier is transferred. The second factor (the multiplicand) is indexed in the keyboard and appears in the K register. Touching the X key activates the multiplication operation and the product appears in the P register. As in division, both factors can be checked with the decimal point prior to touching the X = key. A maximum of two 12 digit factors can be entered and a 24 digit product can be developed.

The multiplication operation is slower than the 130 because the decimal scans all the digits in the product register to find the correct position. On the 130 when an operation is being performed the screen momentarily blanks out while the operation is performed. On the Cogito the operator is aware of the movement involved during the operation and can actually see the decimal point scanning the digits in the product dial to find the correct location. This scanning occurs after the operation and consequently requires more time. Those who have seen both the 130 and the COGITO are aware of a noticeable difference in speed and readily admit that the COGITO IS SLOWER.

The X ACCUM switch is used when the accumulation of products is required. By moving the X ACCUM switch forward, products are accumulated in the product dials. The individual product is not given in this method. Only the accumulated subtotals and total are shown.

TRANSFER KEYS

On the left side of the keyboard there is a group of keys used primarily for the transfer of numbers between registers. The RESET key at the top of the keyboard is used to clear all registers. It is similar to the CLEAR ALL key on the 130. It clears all registers including the storage registers.

A series of four keys marked $Q \rightarrow K$, $Q \rightarrow P$, $P \rightarrow K$, and $P \rightarrow Q$ are used to transfer numbers in the visible display registers. For example, if you wish to make a quotient a multiplicand, the $Q \rightarrow K$ key is depressed and the number in the Q register is transferred to the K register.

The three keys at the bottom of this group marked EXCHANGE, ENTER and RECALL are used in conjunction with the Q and P keys directly above them. The EXCHANGE key will exchange what is in the visible K register with what is in the invisible or storage K register. Depressing the EXCHANGE and P keys, exchanges what is in the visible P register with what is in the storage P register without disturbing the K or Q registers. The same function occurs when the EXCHANGE and Q keys are depressed. The contents of the visible Q register are switched with contents of the storage Q register without disturbing the P or K registers. It should be noted when the EXCHANGE key is used alone it involves the K register only.

The ENTER key, used in conjunction with the P and Q keys, provides the method for entering the contents of the visible K, P or Q registers into the storage K, P or Q registers. If it is necessary to store a product in the P register, simply depress the ENTER and P keys and the number moves to the P storage register. When the ENTER key is depressed alone, the contents of the K register enters the K storage register. Of course, all other registers remain unaffected when a number is stored in a particular register.

The RECALL key uses the same procedure as the EXCHANGE and ENTER keys. The RECALL key used alone, or with the P or Q keys, recalls or transfers a number in one storage register to its companion register in the display.

It is assumed that any number in the storage register is replaced by the number to be stored. This is similar to the 130/132 procedure. If a number is already in the storage register and another number is entered, the first figure is cleared out automatically to make way for the new one. Also, numbers cannot be accumulated in the storage registers. The number must be recalled to the display and accumulated there and then returned to the appropriate storage. Consequently, obtaining individual extensions and a grand total is a complicated procedure since it requires a great deal of transferring.

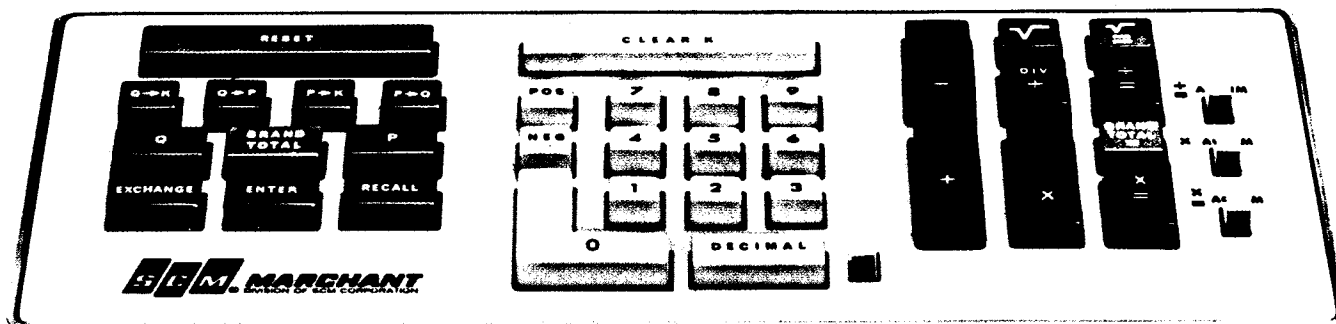
MARCHANT COGITO 240-SR

The COGITO 240SR has all the features of the COGITO 240. In addition to these basic features, it has Automatic Grand Total Multiplication and Square Root.

The Square Root feature involves two keys - the $\sqrt{}$ key and the $\sqrt{=}$ key. The $\sqrt{}$ key is used to enter the radicand and the $\sqrt{=}$ key is used to initiate the operation. The procedure followed is Newton's method. Consequently, an approximation of the square root of the radicand must be entered after the radicand has been indexed and the $\sqrt{}$ key is depressed. After the approximation is indexed in the keyboard the $\sqrt{=}$ key activates the operation.

If a poor approximation is made the time required to extract the root is much longer than when a very close approximation is made. On the 132, this is a two step - one key operation. On the COGITO, the same operation requires 4 steps, two keys and a great deal of operator decision regarding the selection of an approximation.

Automatic Grand Total Multiplication, the accumulation of individual extensions, is a special feature on the COGITO 240SR. Although this operation can be accomplished on the COGITO 240, it requires a great many operational steps. These operational steps have been internally programmed so that the operation is less complicated and faster on the COGITO 240SR.



SPECIFICATIONS

COGITO™ 240-SR ELECTRONIC CALCULATOR

Split-Second Speed with the Utmost Simplicity and Silence!

1. INSTANT ELECTRONIC CALCULATIONS—Solid-state electronic components add, subtract, multiply, divide, store and recall in fractions of a second.

2. SIMPLIFIED KEYBOARD—Basic high-speed 10-key "adding-machine" input. Operating keys grouped to the right for touch operation and ease of operation. Transfer and memory keys grouped to the left for convenience.

3. CATHODE-TUBE VIEWING SCREEN—Exclusive view control makes all numbers sharp and clear in any light. All entries and results are displayed with their correct arithmetic signs.

4. TREMENDOUS CAPACITY—Can multiply two 12-digit numbers and display a 24-digit answer. Decimal point is correctly pointed off within a range of 144 decimal places.

5. AUTOMATIC FLOATING DECIMAL POINT—Absolutely no pre-setting is required. Touching the decimal key automatically points off the decimal in entries...always gives decimally correct answers.

6. AUTOMATIC GRAND-TOTAL MULTIPLICATION—Displays the answers of individual multiplications and automatically accumulates the grand total.

7. THREE STORAGE MEMORIES—Three positive or negative numbers can be stored simultaneously and recalled with their correct sign and decimal as constants in any operation.

8. COMPLETE TRANSFER FLEXIBILITY—All entries or results can be transferred to any register or memory for further use.



9. AUTOMATIC ACCUMULATION OF MULTIPLIERS—Individual multipliers are displayed and are automatically accumulated decimally correct, either positively or negatively.

10. AUTOMATIC ACCUMULATIVE MULTIPLICATION & DIVISION—Positive or negative, in any order, with complete decimal control.

11. AUTOMATIC SQUARING OR RAISING TO A POWER—No need to re-enter intermediate results. The COGITO gives summation of X^2 , $2XY$, Y^2 , X and Y by accumulating squares and multipliers.

12. SQUARE ROOT—The COGITO 240-SR™ computes square roots to the 12th significant digit.



13. AUTOMATIC CLEARANCE—No separate clearance operation is required as previous calculations clear automatically. The reset key instantly clears all visual registers without destroying factors in the memories.

14. AUTOMATIC REPEAT OPERATIONS—Addition, subtraction and multiplication are repeated automatically without re-entries or pre-setting.

15. DISTINCTIVE ZEROS—Half-size zeros permit quick read-out by emphasizing significant figures.

16. THREE-FACTOR PROOF—Multiplier, multiplicand and answer are all displayed decimally correct. An indicator light identifies answer in all calculations.

17. DESK-TOP COMPACTNESS—Uses only 15 inches by 19 inches of desk space...stands just 10 inches high...weighs but a light 35 pounds.

18. STANDARD ELECTRICAL REQUIREMENT—The COGITO operates on standard current, using as little electricity as a 100-watt bulb. Rest position on exclusive three-position switch eliminates costly warm-up time...permits instant "on" operation.

Although a thorough operational knowledge of these calculators is not possible at this time, the following competitive weaknesses are based on the facts that are known. It is felt that further knowledge of the machine will not alter our present competitive critique.

- Both the COGITO 240 and 240SR are highly over-priced in comparison to existing competitive prices. The COGITO 240 costs \$ 1995 and the COGITO 240SR \$ 2195.
- Both the COGITO 240 and 240SR are slower than the 130 and 132.
- Simplicity found on the 130 and 132 are nonexistent on the COGITO. These calculators are extremely complicated to operate.
- Square root on the 240SR is archaic.
- Neither of the COGITO models have the simplicity and flexibility of the Stacking Principle.
- The three storage registers on the COGITO models do not appear to have the flexibility of the storage register and stack on the 130/132.
- Programming required on the COGITO has reduced the computations on these calculators to rotary calculator operations.

In general, it can be said that the Cogito LACKS THE SPEED, SIMPLICITY AND FLEXIBILITY of the 130/132 and the Cogito models are approximately \$ 550.00 more expensive.

OLYMPIA RAE 4-15

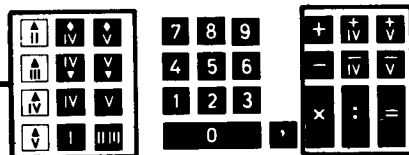
The Olympia RAE 4/15 electronic desk calculator is equipped with a display of Nixi tubes. It is a four functions machine with three essential registers (1 display and 2 calculating registers) and 2 registers (core memories) for storing amounts or memorising constant figures. Each individual register has a capacity of fifteen digits while some answers can be obtained up to 26 digits. However, the division is limited to 14 digits. The floating decimal point is a full automatic feature. All registers are interconnected, so that results can be transferred from one register to another.

The machine is fully transistorized. Its dimensions are 400 x 425 x 200 mm and its weight is 14.0 kg.



The Olympia 4/15 is operated via a 11 key-keyboard and 21 control keys for arithmetical operations, storing and clearance. Those keys can be split up into 5 different groups:

1. clear keys (4 keys)
2. transfer keys (4 keys)
3. check controls (4 keys)
4. store keys (4 keys)
5. function keys for arithmetical operations (5 keys).



Clear key for display (I)



Clear key for calculating registers (II/III)



Clear key storage I register 4



Clear key storage II register 5



Transfer key with clearance of storage I



Transfer key with clearance of storage II



Transfer key without clearance of storage I



Transfer key without clearance of storage II



Check controls for register II



Check controls for register III



Check controls for store I



Check controls for store II



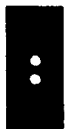
Plus key



Minus key



Multiply key



Divide key



Equal key



Plus key store I



Plus key store II



Minus key store I



Minus key store II

The entry of the amounts is just as on the EC 130; the entry overwrites the contents in the registers except in the storages. In those registers the amounts to be stored are added or subtracted. A transfer from the storages can take place with or without clearance of these storages, depending upon the key to be depressed.

The entry of insignificant zeros is superfluous.

When we compare the Olympia RAE 4/15 with the Friden EC 130, it is important to state that besides some advantages of the RAE 4/15 (such as the capacity of 15 digits and the solution of overcapacity problems) the EC 130 is easier and simpler to operate, needs less operations in order to solve the different problems and has more possibilities.

The capacity of 15 digits sounds to be a great advantage but in fact it is not, because the floating decimal point reduces the capacity considerably. Only in few cases one needs to have all digits right of the decimal point and therefore most people prefer a fixed decimal point location. Although the Olympia RAE 4/15 is able to perform multiplications with products up to 26 digits, it is impossible to store those amounts. The only advantage in this operation is the automatic decimal point setting. On the Friden EC 130 it is also possible to obtain a product up to 26 digits; however, it requires some more operations, while the automatic decimal point location is lacking.

On the other hand Friden EC 130

- ① has only 12 control keys,
- ② enables the operator to store 3 different amounts of which two are always visible,
- ③ needs less operations to solve problems
example:
problem: $6 \times 5 \times 4 \times 3 \times 2 = 720$
on Olympia: $6 \times 5 = \times 4 = \times 3 = \times 2 =$ (8 operations)
on Friden: 6 enter
 5 ×
 4 ×
 3 × (5 operations)
 2 ×
- ④ has a more logical operation (The plus and minus key on Olympia have to be depressed BEFORE the entry of the amounts, while in multiplications and divisions the Mult. and Div. key are depressed AFTER the Entry)
- ⑤ it is not necessary to clear the registers when the machine is set in ON condition

- ⑥ will tolerate a fixed variation in voltage making no errors between those variations. Information was received that in this respect Olympia should not be reliable.
- ⑦ is calculating with algebraic signs, while the Olympia is working with complimentary numbers, which have to be transferred. Also in further operations those negative amounts on the Olympia will prove to be very inconvenient and will cause many difficulties.
- ⑧ has an overflow lock key and locks the keys, the decimal as well as the function keys. When the capacity of the Olympia has been exceeded only a signal lights up and there will be no lock of the keys. That means that in some cases specially for fast operators it is difficult to know when the capacity is exceeded.

The price of the Olympia 4/15 in Germany is DM 5.850.

SAGE I

The SAGE I is developed by DERO RESEARCH & DEVELOPMENT CORP.



SPECIFICATIONS:

- Size: Height - 6 3/8 inches, Width - 12 1/4 inches, Depth - 12 13/16 inches
- Weight: 12 Pounds
- Capacity: Calculation capacity to 20 digits. Any number up to 9,999,999,999 displayed. 'Double Precision' feature permits display of both the ten most significant digits and the ten least significant digits of any result in either sequence.
- Display: Bright, segmented screen. Most significant zeros blanked. Large, easy viewing digits - each 7/8 inches high by 5/8 inches wide.
- Speed: Addition, Subtraction - 0.008 seconds typically
Multiplication, Division - 0.25 seconds typically.

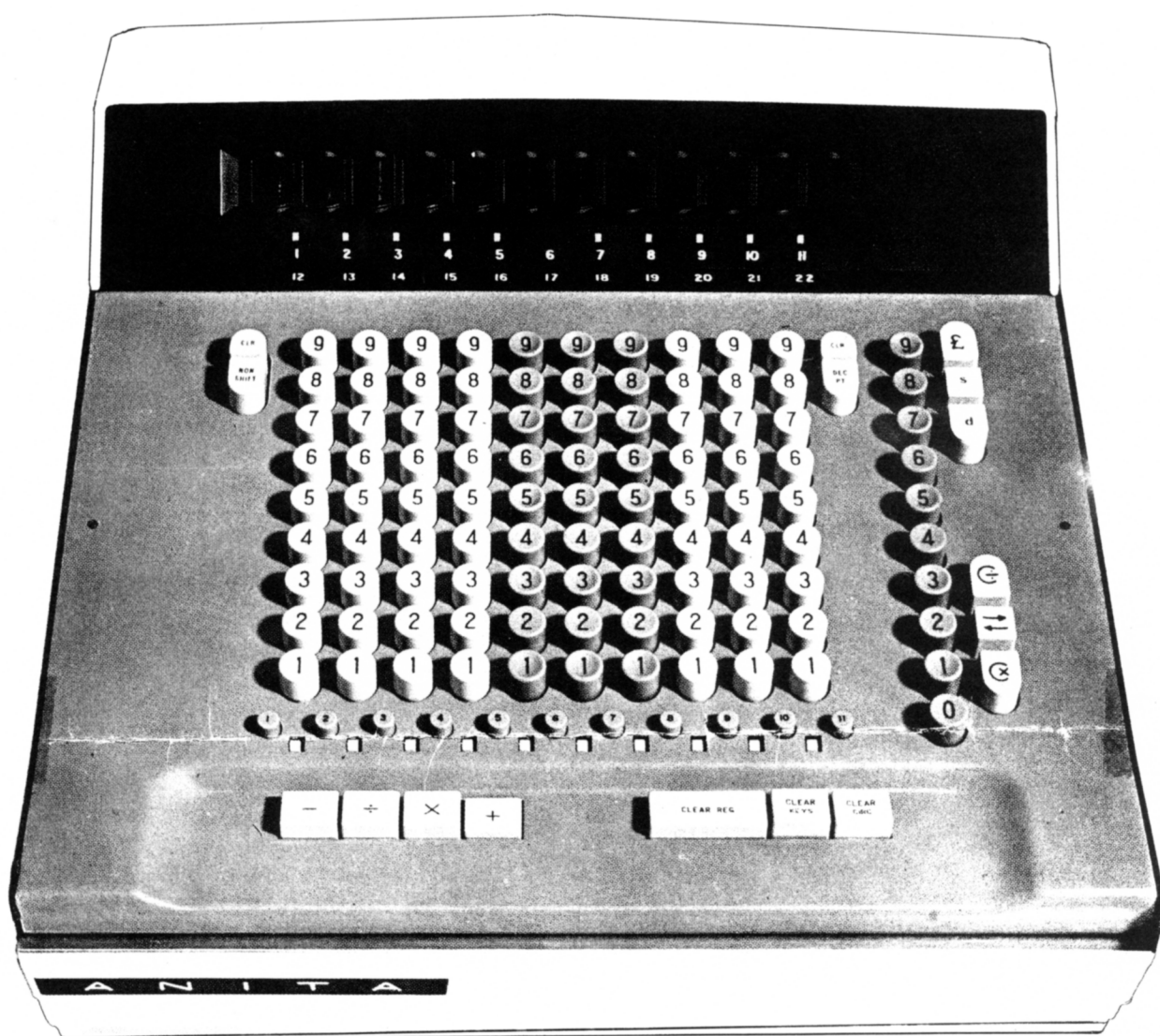
- Registers: Four registers including two entry registers, one of which is for constants; a working register and the answer register which also serves as an entry register.
- Keyboard: Ten-key keyboard for numbers.
Four keys for commands (+ - \times \div).
One key to enable use of Memory or to change the Memory register (M).
One key for the accumulation of products or quotients (\times \div).
A clear key (C).
A display key for double precision answers (D).
Equals or commence calculating key (=).
- Memory: Memory register may be entered from keyboard or by storing the answer.

This machine looks more like a toy than anything else, primarily because of the cheap plastic case and the apparent low degree of reliability. With no decimal control it ranks with the conventional low cost printing calculators in ability at the relative high price of \$ 995. The manufacturer is also a very small company and cannot be considered a significant factor in the calculating machine industry.

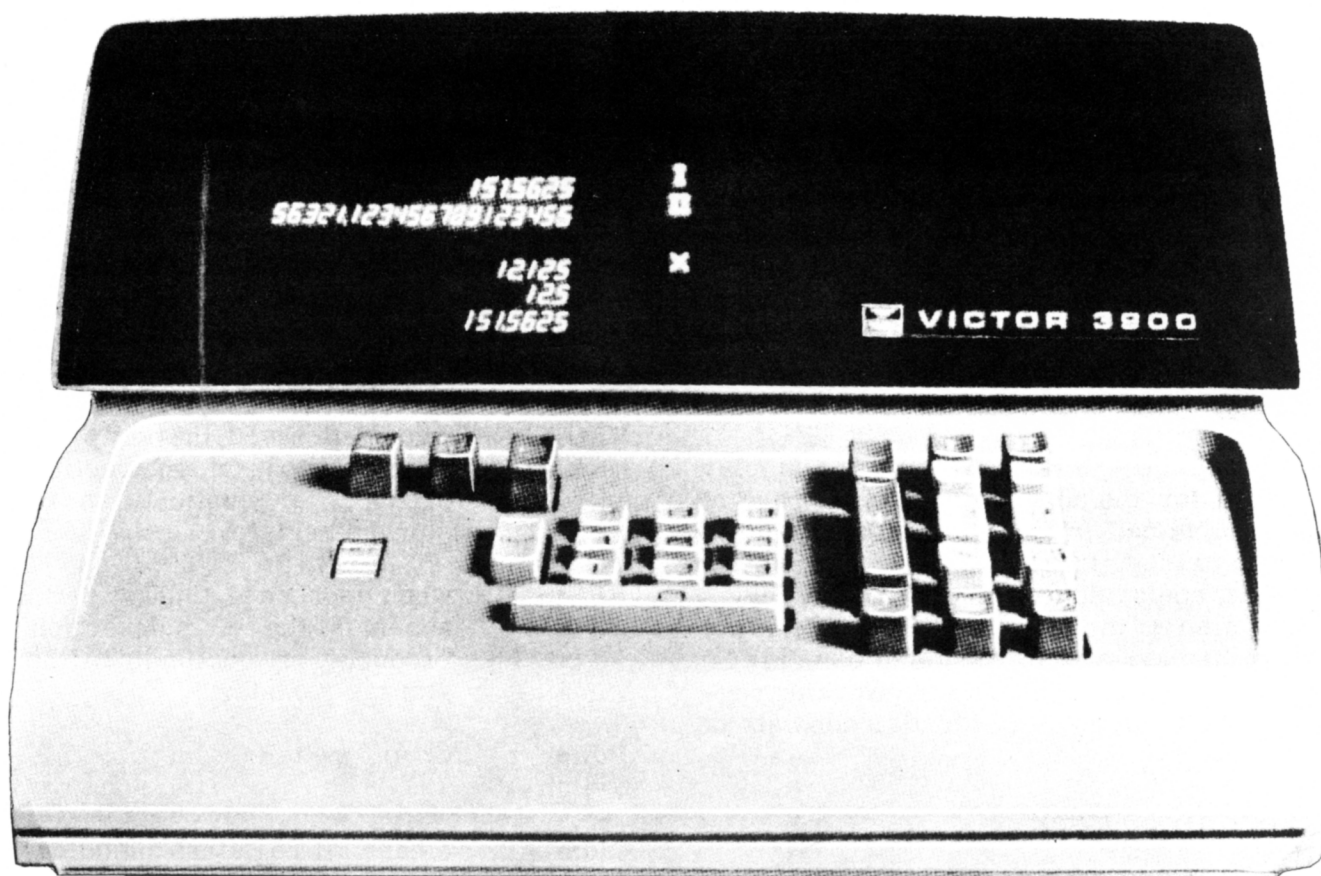
SUMLOCK COMPTOMETER LTD

In a former Product Information, issued in February 1965, the ANITA Mark 8 and 9 have already been compared with the EC 130.

The Sumlock Comptometer Ltd. recently announced a new model the ANITA Mark 10. This new unit equipped with dual character - sterling and decimal programme - joins the ANITA Mark 8 and 9. It provides the facilities of being able to convert any decimal results into an £, sh., d. equivalent. It calculates directly whole numbers, fractions or discount values at an £.sh.d. rate to give a sterling result.



VICTOR 3900



The dimensions of the 3900 are approximately 20'' long, 11'' wide and 7 - 1/2'' high and it weighs 24 pounds. It incorporates an integrated electronic circuit consisting of 30 chips in contrast to the transistorized circuitry found in the 130. It has a cathode ray tube on which five registers may be viewed. However, this calculator does not have the stacking principle which is used in the 130 display.

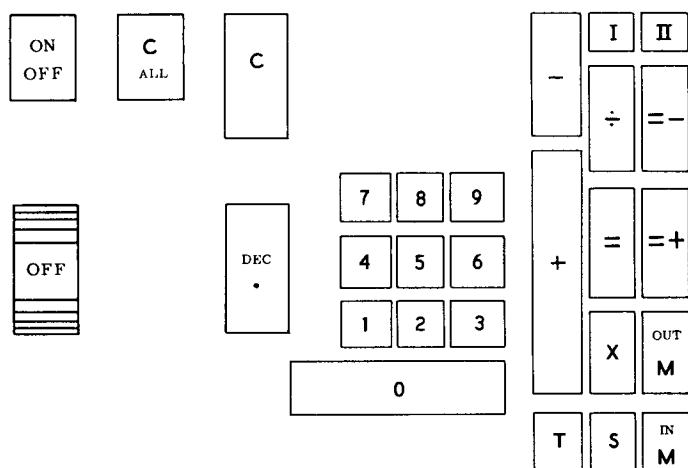
DISPLAY

Each register in the display has 20 digit capacity. Insignificant zeros to the left of a number in any display register are not visible. The register at the bottom of the display is the working register and is used to illustrate all entries and answers. At the completion of a multiplication or division problem the factors, which were viewed in the working register when entered, appear in the second and third registers from the bottom. Consequently, visual proof of both factors and answer in both multiplication and division is accomplished after the operation is completed.

The I and II registers at the top of the display are used for the accumulation or storage of results obtained in the working register. In addition to these five visual registers, a sixth register, equivalent to the 130 memory register, is also on the 3900. This register is not on the display and its contents can only be viewed by recalling them to the working register. The memory register also consists of 20 digits.

KEYBOARD

The keyboard consists of 16 function keys, an eleven-key keyboard including the decimal point key, and a round-off indicator dial.



The 16 function keys are as follows:

+	used for all factors in an addition problem
-	used for a number that is to be subtracted
\times	used to enter the multiplicand
\div	used to enter the dividend
=	used to initiate both the multiplication and division operations
TOTAL	transfers the contents of storage registers I and II to the working register.
SUB-TOTAL	duplicates the contents of storage registers I and II in the working register.
=+	used to accumulate products or quotients in Registers I or II.
=-	used to subtract products or quotients in Registers I or II.
MEMORY IN	duplicates the contents of the working register in the memory register. The number also remains in the working register.
MEMORY OUT	duplicates the contents of the memory register in the working register. The duplicated number also remains in the memory register.
REGISTER I KEY	when depressed, this key permits accumulation or subtraction of products or quotients in the I storage register.
REGISTER II KEY	when depressed, this key permits accumulation or subtraction of products or quotients in the II storage register.
Power Switch	On/off switch
Clear All	clears all registers including the memory register.
Clear Keyboard	clears the working register.

The 11-key keyboard includes a decimal point key. A floating decimal point principle is incorporated in this calculator. The decimal point key is used as on the 130, whenever the decimal point key appears in the number. A fixed decimal is not incorporated. Consequently all factors appear in the display with only the decimal numbers after the decimal point that were indexed on the keyboard. The answer appears in the working register. The location of the decimal point in the answer is the sum of the decimals in the factors. The following illustration indicates how the display would look after 12.125×1.25 have been multiplied.

```
12.125
  1.25
15.15625
```

The half-cent round-off indicator dial has the following selections or positions: off, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 15. In the 'off' position, round-off does not occur and the decimal point in the answer is located at a position equal to the sum of the decimal places in the factors. When the round-off indicator dial is on one of the numerical selections, the number of decimal places in the answer is determined by the selection of the indicator, regardless of the number of decimals in the factors. However, the answer is rounded off automatically. The right-most digit in the working register has been adjusted automatically (if round-off was required).

When working with dollars and cents in an invoicing problem, the factors can be entered with as many decimal places as are required. The answer is printed at decimal two, rounded off to the nearest cent. The following example will illustrate this procedure.

3-1/3 tons at \$ 12.45/T - 41.4999585

1. Set round-off indicator dial at 2
2. Index 3.33333
3. Touch X
4. Index 12.45
5. Touch =

The display would appear as follows:

```
3.33333
 12.45
41.50
```

The answer 41.50 is in the working register at decimal two, rounded off to the nearest cent.

A round-off indicator selection is also used to indicate the number of decimal places required in the quotient of a division problem. While the 'off' position could be used for most division problems, complications can arise when the divisor has more decimal places than the dividend. Use of the round-off indicator eliminates any such problem and gives a decimally correct rounded-off answer. The number of decimal places in the answer depends upon the setting of the round-off indicator.

OPERATIONS

The basic operations of addition, subtraction, multiplication and division are described in the following paragraphs.

Addition and Subtraction

These operations must start by depressing the clear (entry) keyboard key. As the first factor is indexed in the keyboard, it appears simultaneously in the working register. When the entire factor has been indexed, the + key is depressed. While no visual change takes place in the display, actually, the indexed number is being accumulated to the zero condition in the working register.

When the second factor is indexed on the keyboard, the first factor disappears from the working register. The + key is again depressed and the accumulated sum of the two factors appears in the working register. The same operation applies to subtraction.

Repeat addition and subtraction can also be accomplished on the 3900. If the plus or minus key is depressed without a keyboard entry, the last number entered is accumulated or subtracted from the previous subtotal. For example, if 12 is to be repeat added several times, simply index 12 and touch the plus key as many times as required.

Multiplication

Although clearing is NECESSARY in the addition and subtraction operation, AUTOMATIC clearing is featured in multiplication and division. It is assumed that the automatic clearing occurs when the first digit of the first factor of a multiplication or division problem is indexed on the keyboard.

The multiplicand is indexed on the keyboard and the X key is depressed. This factor appears in the working register simultaneously as it is being indexed in the keyboard. As the multiplier is being indexed in the keyboard, the multiplicand disappears and the multiplier appears in the working register. When the = key is depressed the product appears in the working register, the multiplicand in register # 3 and the multiplier in register # 2. An X symbol appears next to the multiplicand in register # 3.

The X symbol indicates that the multiplicand is a constant, if desired. Consequently, by entering a new multiplier and touching the equal key, the constant multiplicand is multiplied by any multiplier on the keyboard.

If, during a normal multiplication operation, the \pm or \mp keys were depressed, the product would appear in the working register -- just as it does when the $=$ key is depressed. Moreover, this product would be accumulated or subtracted simultaneously from storage registers I or II..... exactly which one would depend upon whether storage I or II had been depressed. This operation would therefore provide individual extensions and grand total.

If, after a product had been developed in the working register, a third factor is to be multiplied by the product, merely touch the \times key to make the product a multiplicand and index the third factor and touch the $=$ key. Chain multiplication ($A \times B \times C$), therefore, is a function of the 3900.

Division

As previously described, the round-off indicator is set for the number of decimal places required in the quotient. As the dividend is indexed on the keyboard it simultaneously appears in the working register. The \div key is depressed; then the divisor is indexed in the keyboard and the $=$ key is depressed. As the divisor is being indexed, the dividend disappears from the working register and the divisor appears in its place. After the $=$ key is depressed the dividend appears in register # 3, the divisor in register # 2 and the quotient in the working register.

A \div symbol next to the divisor indicates that it can be used as a constant if desired. Simply indexing a new dividend in the keyboard and touching the equal key produces a quotient developed by dividing the new dividend by the constant divisor.

Accumulation or subtraction of quotients in storage register I or II is performed by depressing the \pm or \mp key instead of the $=$ key in the normal division operation. The individual quotient appears in the working register and the accumulated or subtracted total in the storage registers. The storage register used is determined by pre-setting the I or II keys.

Storage Registers

Any number appearing in storage register I or II may be recalled to the working register by depressing the total key. This literally takes the number from the storage register in which it no longer appears and transfers it to the working register. If the sub-total key is used, the number is transferred to the working register but also remains in the storage register.

Memory

The 3900 operates similarly to the memory on the 130. Any number in the working register may be entered into the memory by merely depressing the 'memory in' key. However, the number remains in the working register. As on the 130, when the 'memory out' key is depressed the number in memory is duplicated in the working register and also remains in memory.

It is possible to store four constants simultaneously on the 3900 a constant divisor or multiplicand; a number in the memory and numbers in storage registers I and II. However, a constant multiplicand can only be used as such, as long as the operation remains multiplication. If the operation changes, of course, the so-called constant is lost.

COMPETITIVE CRITIQUE

1. Without the stacking principle, scientific problems would be more complicated than on the 130/132.
2. There is no automatic square root and manual square root is difficult.
3. There is no CHANGE SIGN key.
4. There is no REPEAT key.
5. Clearing is required in both addition and subtraction.
6. Chain multiplication requires an additional step.
7. The machine is priced at \$ 1825 which is a high price for a business oriented calculator.

Electronic Japanese Calculators

In Japan there is a tremendous activity in the manufacture of Electronic Calculators. Companies that a year ago did not market a single piece of office equipment are beginning to flood the market. Almost all have only one advantage namely the price.

Please find below a comparison list of the Japanese Electronic Calculators and the EC 130.

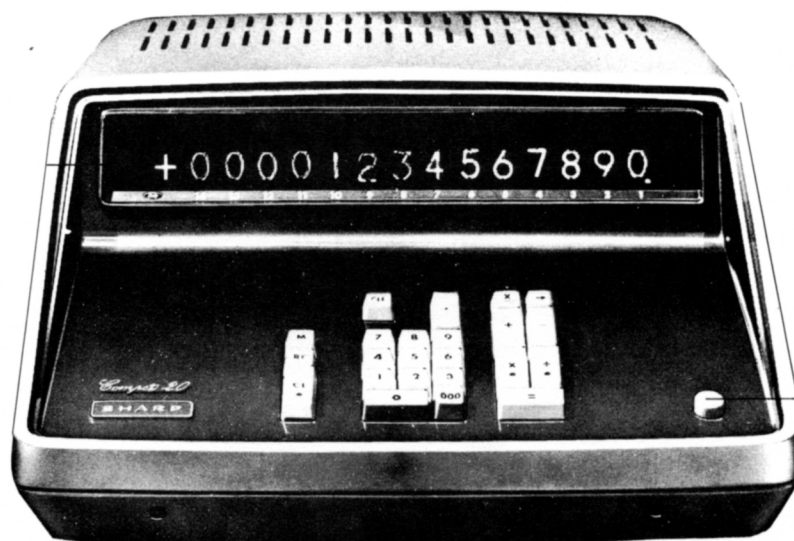
Remarkable in this case is that up to now no electronic PRINTING calculator has been developed in Japan. That is probably due to the fact that the mechanical side of this Japanese industry is a weak point. Also the working of the 10 key keyboard is critical and not reliable until now.



Decimal Point	Automatic, floating system	Automatic, floating system.	Automatic, floating system	Automatic, floating system	Automatic, floating system	Automatic, floating system	Automatic, floating system	Automatic, floating system
Credit Balance	Complement, but by depressing $\boxed{=}$ (Neg. Equal) key true credit balance is available with minus sign	Yes (— sign display)	Complement, by depressing $\boxed{=}$ key true credit balance is available with minus sign.	Yes (— sign displayed)	Complement only	Yes (— sign displayed)	Automatic, floating system	Automatic, floating system
Change Sign Key	No	No	No	No	No	No	No	Complement, but by depressing $\boxed{=}$ (minus) key, true credit balance is available
Memory	No	No	No	YES, can be used for individual & accumulative multiplication	No	Yes, (Memory key & Recall key)	One 16 digits	No
Addition $A + B$	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{+}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{+}$
Subtraction $A - B$	$A \boxed{-} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{-}$ 4 steps	$A \boxed{-} B \boxed{=}$ 4 steps	$A \boxed{-} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{-}$ 5 steps	$A \boxed{-} B \boxed{=}$ 4 steps	$A \boxed{-} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{-}$
Multiplication $A \times B$	$A \boxed{\times} B \boxed{=}$ 4 steps	$A \boxed{\times} B \boxed{=}$ 4 steps	$A \boxed{\times} B \boxed{=}$ 4 steps	$A \boxed{\times} B \boxed{=}$ 4 steps	$A \boxed{\times} B \boxed{=}$ 4 steps	$A \boxed{\times} B \boxed{=}$ 4 steps	$A \boxed{\times} B \boxed{=}$ 4 steps	$A \boxed{\times} B \boxed{=}$
Division $A \div B$	$A \boxed{\div} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$ 4 steps	$A \boxed{+} B \boxed{=}$
Chain Multiplication $A \times B \times C$	$A \boxed{\times} B \boxed{\times} C \boxed{=}$ 7 steps	$A \boxed{\times} B \boxed{\times} C \boxed{=}$ 7 steps	$A \boxed{\times} B \boxed{\times} C \boxed{=}$ 7 steps	$A \boxed{\times} B \boxed{\times} C \boxed{=}$ 7 steps	$A \boxed{\times} B \boxed{\times} C \boxed{=}$ 7 steps	$A \boxed{\times} B \boxed{\times} C \boxed{=}$ 7 steps	$A \boxed{\times} B \boxed{\times} C \boxed{=}$ 7 steps	$A \boxed{\times} B \boxed{\times} C \boxed{=}$
Accum. Mult. $A \times B = C$ $+) D \times E = F$ $C + F$	Depress \boxed{A} key $A \boxed{\times} B \boxed{=}$ 9 steps $D \boxed{\times} E \boxed{=}$	Depress \boxed{XII} key $A \boxed{\times} B \boxed{=}$ 9 steps $D \boxed{\times} E \boxed{=}$	$M \boxed{A} \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ 9 steps	\boxed{Z} Key $A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ 9 steps	No	Depress \boxed{A} key $A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ 10 steps	$A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ By depressing \boxed{A} key, individual product can be obtained and by depressing \boxed{D} key, total products can be available.	$A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ Individual product can not be available
Neg Mult. $A \times B = C$ $-) D \times E = F$ $C - F$	Depress \boxed{A} key $A \boxed{\times} B \boxed{=}$ 9 steps $D \boxed{\times} E \boxed{=}$	\boxed{XII} $A \boxed{\times} B \boxed{=}$ \boxed{XIII} $D \boxed{\times} E \boxed{=}$ 10 steps	$M \boxed{A} \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ 9 steps	\boxed{Z} Key $A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ 9 steps	No	Depress \boxed{A} key $A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ 11 steps	$A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ Same as the above	$A \boxed{\times} B \boxed{=} C \boxed{\times} D \boxed{=}$ Individual product can not be available
Constant Mult. $A \times B =$ $A \times C =$ $A \times D =$	$A \boxed{\times} B \boxed{=}$ $R \boxed{\times} C \boxed{=}$ $R \boxed{\times} D \boxed{=}$	use '10 constant dials'. Set constant figures into Dials. Depress \boxed{KEY} key. $B \boxed{\times} D \boxed{=}$ * \boxed{DE} means 'Dial Equal' $C \boxed{\times} D \boxed{=}$ $D \boxed{\times} D \boxed{=}$	$A \boxed{\times} B \boxed{=}$ RC $R \boxed{\times} C \boxed{=}$ means 'Recall' $R \boxed{\times} D \boxed{=}$	Use '7 constant dials'. Set constant figures into Dials. $B \boxed{\times} C \boxed{=}$ $C \boxed{\times} D \boxed{=}$ $D \boxed{\times} D \boxed{=}$	Multipplier will not be cleared unless \boxed{C} key is depressed Yes $A \boxed{\times} B \boxed{=}$ $C \boxed{\times} D \boxed{=}$ $D \boxed{\times} D \boxed{=}$	Multipplier will not be cleared unless \boxed{C} key is depressed Yes $A \boxed{\times} B \boxed{=}$ $C \boxed{\times} D \boxed{=}$ $D \boxed{\times} D \boxed{=}$	$A \boxed{\times} B \boxed{=}$ $C \boxed{\times} D \boxed{=}$ $D \boxed{\times} D \boxed{=}$	$A \boxed{\times} B \boxed{=}$ $C \boxed{\times} D \boxed{=}$ $D \boxed{\times} D \boxed{=}$

	CANOLA 130	SHARP COMPET CS-10A	SHARP COMPET CS-20A	CASIO 001	UNICON 160	ALEPH-ZERO 101	CANOLA 161	TOSCAL (BC-1001)
Keyboard	10 key	Full key	10 key	10 key	10 key	10 key	10 key	10 key
Function key	8	18	11	14	10	14	11	11
Display Window	Discharge Tube, 1 register 13 digits	Neon-Tube 1 register 20 digits	Neon-Tube 1 register 14 digits	Neon-Tube 1 register 10 digits	Neon-Tube 16 digits	Neon-Tube 1 register 10 digits	Discharge Tube 1 register 16 digits	Discharge Tube 1 register 10 digits
Computing Speed	+ 0.01 sec. - 0.01 sec. x 0.25 sec. + 0.5 sec.	+ 0.012 sec. - 0.016 sec. x 0.4 sec. + 0.8 sec.	+ 0.06 sec. - 0.06 sec. x 0.1 sec. + 0.5 sec.	+ 0.01 sec. - 0.01 sec. x 0.4 sec. + 0.4 sec.	+ 0.01 - 0.1 sec. - 0.01 - 0.1 sec. x 0.1 - 0.96 sec. + 0.24 - 0.66 sec.	+ 0.01 sec. - 0.01 sec. x 0.36 sec. + 0.44 sec.	+ 0.01 sec. - 0.01 sec. x 0.3 sec. + 0.4 sec.	+ 0.01 sec. - 0.01 sec. x 0.35 sec. + 0.5 sec.
Digit	Dig. Dig. Dig. 13 + 13 = 13 13 x 13 = 13 11 + 11 = 11 12 digits - Divisor's Dig. Overflow indication is not available	Dig. Dig. Dig. 10 + 10 = 20 10 x 10 = 20 20 + 10 = 10	Dig. Dig. Dig. 14 + 14 = 14 14 x 14 = 14 13 + 13 = 13 When overflow lamp is on, by using $\sqrt{\quad}$ key, whole answer is available	Dig. Dig. Dig. 10 + 10 = 10 10 x 10 = 20 9 + 9 = 9 * Constant Dial 7 digits * Overflow lock is not available * By depressing $\sqrt{\quad}$ key 20 digits answer is available.	Dig. Dig. Dig. 16 + 16 = 16 15 x 15 = 16 14 + 7 = 8 $\sqrt{14} = 7$ Overflow key is not available	Dig. Dig. Dig. 10 + 10 = 20 10 x 10 = 20 20 + 10 = 10 $\sqrt{9} = 9$ By depressing $\sqrt{\quad}$ key 20 digits answer is available. Overflow key is not available	Dig. Dig. Dig. 16 + 16 = 16 15 x 15 = 16 14 + 14 = 14	Dig. Dig. Dig. 10 + 10 = 10 10 x 9 = 10 10 + 9 = 10 (By depressing $\sqrt{\quad}$ key, another 9 digits is available) 10 + 9 = 10 (By depressing $\sqrt{\quad}$ key, remainder can be available)
Sequential operations $\frac{A \times B}{(C \div D) \pm (E \times F)}$	No	No	No	YES, but complicated 18 steps	No	Complicated	Yes (by using memory)	No
Square Root \sqrt{A}	No	No	No	No	Yes A $\sqrt{\quad}$ \equiv	Yes complicated	No	No
Weight	18 kg	25 kg	16 kg.	17 kg.	23 kg.	48.5 kg.	19.5 kg.	18 kg.
Selling price (YEN)	360,000.-	535,000.-	CS-20A 379,000.- CS-21A 435,000.-	380,000.-	550,000.-	880,000.-	445,000.-	360,000.-
Manufacturer	Canon Camera Co. Ltd.	Hayakawa Electric Mig. Co., Ltd.	Hayakawa Electric Mig. Co., Ltd.	Casio Computer Co. Ltd.	Nippon Calculator Co. Ltd.	Oi Electric Co. Ltd.	Canon Camera Co. Ltd.	Tokyo Shibaura Electric Co. Ltd.

In our opinion the Canola 130 and the Sharp Compet CS 20A are the keenest competitors. Therefore one of them is described in details:



This model which is quite similar to the Canola 130 has a 10 key keyboard. It is designed to carry out addition, subtraction, multiplication and division. The machine automatically clears, calculates and positions the figures, including the decimal point if required.

Features include:

- Automatic multiplication positive or negative with prior proof and instant recall of both factors.
- Automatic positioning of decimal point at all times even in mixed and successive arithmetical functions.
- Automatic back-transfer of products, sums and quotients.
- Constant feature
- Memory store
- Automatic division with line-up and decimal place cut-out.
- Automatic positive/negative indicator.
- Stage by stage corrector.

The price in England is £ 495. The machine is manufactured by Hayakawa Electric Company Ltd., Osaka. It has a Nixi tube display with a capacity of 14 digits + sign.

Electronic Printing Calculators

MONROE EPIC 2000

Monroe's EPIC 2000 is an electronic printing calculator comprised of two units, a mechanical printer that is cable connected to an electronic calculation device. The mechanical printer, similar to the Monroe PC 1421 printing calculator, is used solely for input and readout of all numerical computations, while the electronic unit does all the actual computations.

The printing unit, adding machine in appearance, is entirely mechanical and causes the operation of the calculator to be considerably noisier than the 130. The electronic unit, housed in a metal case, is about the same size as an attache case. It is designed to set upright under a desk or table with a bulky cable connecting the two devices. The combined weight of both units of the EPIC 2000 is 60 pounds (30 pounds per unit). Size, weight and awkward cable make the 2000 anything but portable.

Like the 130, the EPIC 2000 has four registers arranged in a stack. These registers have all of the capabilities of the stacking principle.

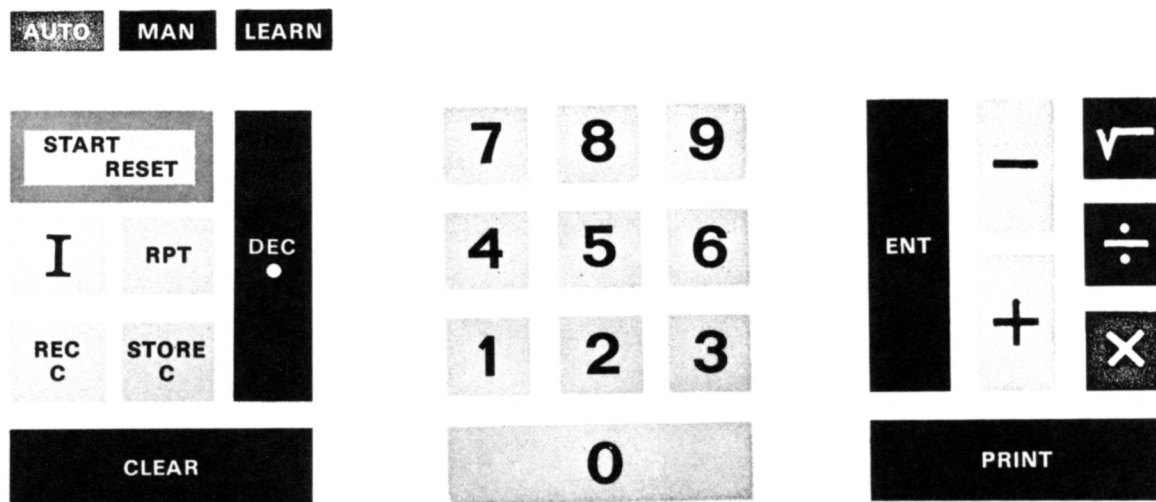
In addition to these four registers, there is a storage or memory register in which a constant can be stored. The only difference between the registers on the 2000 and the 130 are the capacity and the display of the numbers in the registers.

The capacity of the 2000 is 16 digits, while the 130 provides 13-digit entry. However, the 2000 has only two decimal positions, at 4 and 8. But the 130 offers more flexibility with five decimal positions. The limited number of decimal point selections on the 2000 precludes the possibility of overcapacity problems which can be done on the 130. The truncation of decimals to the right of the decimal point and the overflow situation which occurs when answers or entries exceed the number of places provided to the left of the decimal point, are identical to the 130.

Rather than display the contents of the four registers on a cathode ray tube, like the 130 does, the numbers are printed on a tape as they are entered in the working register of the 2000. Intermediate operations and the movement of numbers between registers is not printed on the tape. Therefore, the operator is never really aware of how many registers are being used or where the numbers are. Also, there is a danger of losing numbers off the top of the stack.

KEYBOARD COMPARISON

A comparison of the keys between the 130 and the EPIC 2000 will clearly indicate the function of each key on the 2000. The comparison follows.



Epic 2000

ENTER
DEC
Decimal Point
Selector

(Same as 130)
,,

FRIDEN 130

ENTER
DECIMAL POINT
Decimal Point
Selector

On the Epic 2000, the decimal point selector has only two positions at 4 and 8. Entry of numbers around the preselected decimal point is identical to the 130 operation. Truncation and overflow is the same, except that the Epic 2000 will not print overcapacity numbers.

+	(Same as 130)	+
-	,,	-
×	,,	×
÷	,,	÷
CLEAR	,,	CLEAR ENTRY
START/RESET	,,	CLEAR ALL
REC/C	,,	RECALL
STORE/C	,,	STORE

On the 130, all numbers are entered in the memory or storage register through the working register. When the STORE key is depressed, the number moves from the working register to the storage register. On the Epic 2000, the number also enters through the working register. But when the STORE key is depressed, the number also remains in the working register.

RPT	(Same as 130)	REPEAT
PRINT		NONE

The PRINT key is used to print any answer. All numbers indexed on the keyboard are printed when either the ENTER key or a function key (+, -, ×, :) is depressed. The result of the operation is not printed unless the print key is depressed. Whether the answer is printed or not, it remains in the working register until a new entry causes it to move up the stack, or the depression of an operation key causes it to be used as the factor. Printing an answer does not remove it from the working register, and only the number in the working register can be printed.

I (Invert key)	NONE
----------------	------

This key is used to reverse the position of the contents of the working register and register #2. Its primary purpose is to allow print-out of what was in register #2 in order to determine the contents of that register. Since only the number in the working register can be printed and since there is no visual display, the contents of register #2 (during even a simple problem) can be forgotten or cause doubt.

Consequently, by depressing the invert key and the print key, the contents of the working register and register #2 are reversed. This allows the print-out and visual proof of what was in register #2 (now in the working register).

Re-inverting the numbers is not necessary if the next subsequent operation is multiplication. However, if the next operation is division, re-inverting the registers is required. This is accomplished by depressing the Invert key again.

√(Square Root key)	NONE
--------------------	------

Any number indexed on the keyboard becomes the radicand when this key is depressed. It is not necessary to touch the enter key first. Depressing the square root key will print the number (radicand) indexed on the keyboard on the tape, and extract the square root of the number.

The square root is not printed unless the print key is depressed. Any number which is in the working register, whether it was indexed in the keyboard or is the resulting answer of some previous operation, can be used as a radicand. And the square root of it can be extracted.

Also, since the result of a square root operation is in the working register, the root of the root can be extracted by merely depressing the square root key a second time.

PROGRAM FEATURE

Three buttons, located directly above the start/reset key, are used for the programming function of the Epic 2000. These buttons are labeled AUTO (automatic), MAN (manual), and LEARN. When the Manual button is depressed, the programming feature is not operable and the Epic 2000 functions in a normal fashion.

When the Learn button is depressed, the next 14 steps performed on the calculator are memorized in sequence. The following example will illustrate this procedure.

$$\begin{array}{r} 145, \\ \hline 12 \end{array} \quad \begin{array}{r} 156, \\ \hline 12 \end{array} \quad \begin{array}{r} 196 \\ \hline 12 \end{array}$$

Index 12 on the keyboard and depress the store key. Depress the Learn button.

Program steps

- Step 1 Index 145 and touch the Enter key
- Step 2 Touch Recall
- Step 3 Touch :
- Step 4 Touch Print

The first answer is printed on the tape, and the program has been learned for the rest of the problems. By depressing the AUTO (automatic) button, the program will be automatically repeated except for the variables.

The automatic program will stop only when a new variable is to be entered. In the above program, step 1 requires a variable to be indexed on the keyboard and the enter key to be depressed. This step is not a part of the learned program as such, it is merely a stop signal in the program so the operator can enter the required variable.

Since the first step in the second fraction is to enter a variable, the operator indexes the 156 on the keyboard and touches the Enter key. The 156 is printed on the tape and the calculator automatically accomplishes the next three steps and prints the answer. The program stops after the answer to the second fraction is printed.

Now the operator indexes the numerator of the third fraction, 196, on the keyboard and touches the Enter key. Again, the indexed variable is printed. And after the calculator performs the program steps, it prints the answer to the final fraction.

This program involved four program steps. The program may be stored while manual operations are performed by touching the manual button. When the stored program is required again, depressing the AUTO button permits reuse of the program. A program may be cleared from the calculator by depressing the learn key. The learn key automatically clears the existing program from the calculator and allows entry of a new program.

An advantage of the programming feature is that it allows programming of simple as well as complex operations. The operator is required only to index the variables on the keyboard and touch the enter key. This simplifies the touch system considerably. The following procedure will illustrate this advantage.

$$\begin{array}{r} 123, \\ \hline 13 \end{array} \quad \begin{array}{r} 152, \\ \hline 46 \end{array} \quad \begin{array}{r} 14367,89 \\ \hline 12 \end{array} \quad \text{etc.}$$

Depress the learn button

Program Step 1 Index 123 and touch enter
Program Step 2 Index 13 and touch ÷
Program Step 3 Touch Print

Depress the automatic button
Index 152 and touch enter
Index 46 and touch enter

Although there are only three program steps to this problem, there are five normal steps or things that are done. Using the program function for this problem only saves one step (the print step). However, after the program is established, the operator indexes the factor and touches only the enter key for all of the rest of the division problems.

COMPLICATED PROGRAMMING

In order to achieve simplicity, a complicated programming procedure must first be accomplished. The end, simplicity, does not justify the means, the complicated programming procedure. Also, since most computations involve a combination of arithmetic operations, not necessarily in the same sequence, nor in sufficient quantity to justify programming, this feature will seldom be used by most purchasers.

Monroe salesmen, eager to point out this exclusive feature, will overdramatize its significance in an effort to sell calculators. The best way to combat this selling point is to thoroughly understand the customer's applications and requirements to determine the real validity of the programming feature. If the programming feature is not a necessity the customer will be performing more operational steps on the Epic 2000 for all operations than he would on the Friden 130.

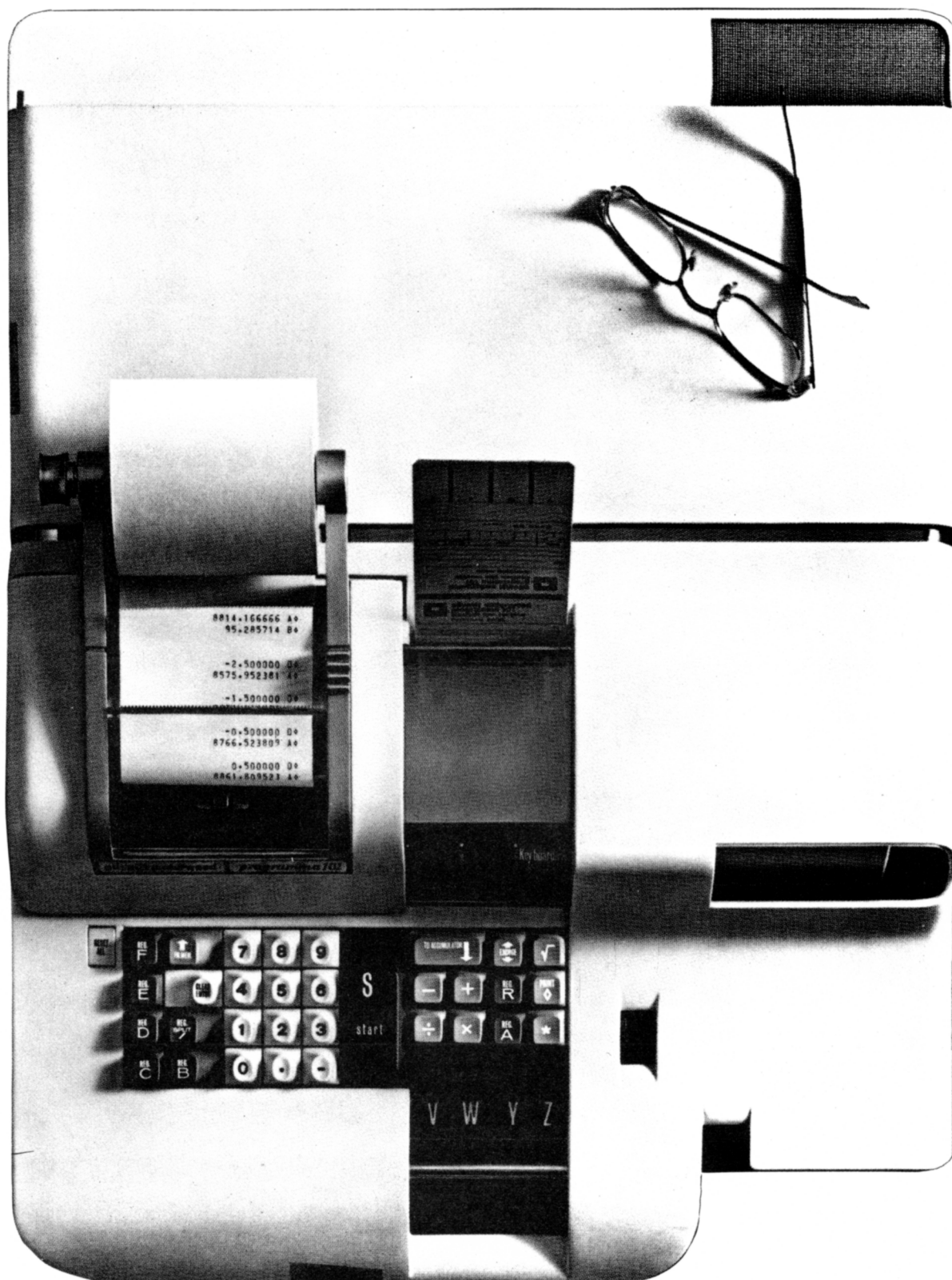
Some areas where the programming feature on the Epic 2000 would be an advantage and save both operation steps as well as time would be statistical summations, amortization schedules, evaluation of a formula with changing values, etc. If the calculator is used solely for this type of problem, ninety percent of the time, the Epic 2000 does have the advantage.

Summarizing, the following summation of competitive points will assist your sales approach.

- Insufficient Decimal Selections.
- Because the operator is never aware of the position or movement of numbers between the registers, the lack of a visual display makes the Epic 2000 more difficult to use.
- The Epic 2000 is definitely not portable.
- Additional steps are required for all manual operations, such as addition, subtraction, multiplication and division. This is the result of being required to depress the print key for the print out of the answer to these operations.
- This calculator is noisy compared to the 130.
- The size of the printed symbols and numbers on the tape is half the size of those on the 130.
- An over-complicated procedure for entry of signed numbers.
- The motor on the printer is continually running while the calculator is on.
- The price of the Monroe Epic 2000 is \$ 2000.

OLIVETTI PROGRAMMA 101

Olivetti recently introduced an electronic printing calculator: the Olivetti Underwood Programma 101.



Programma 101 is a self contained desk top electronic calculator, with an easy operation. It provides in one unit the ability to create, store and record programs in 'its' memory to control a series of operations. It is only necessary to enter variables to obtain the solution of a problem. The significant thing is that the Programma 101 is a 'self programming calculator' (it memorizes function key strokes in sequence) capable of storing up to 120 steps and has a self contained read/write head for magnetically recording or transcribing the programs in a permanent medium.

The machine has 10 registers. It was announced that those registers have a capacity of 22 digits, plus decimal point and sign for entry and storage. Our understanding, however, is that there are five 22-digit registers, addressed by the keys labeled B, C, D, E and F and that these five registers may be split to give the effect of ten 11-digit registers.

The Programma 101 has conditional jump, the V, W, Y and Z keys being used for program address. The decimal system is good in that they can program the number of decimal positions desired in the answer.

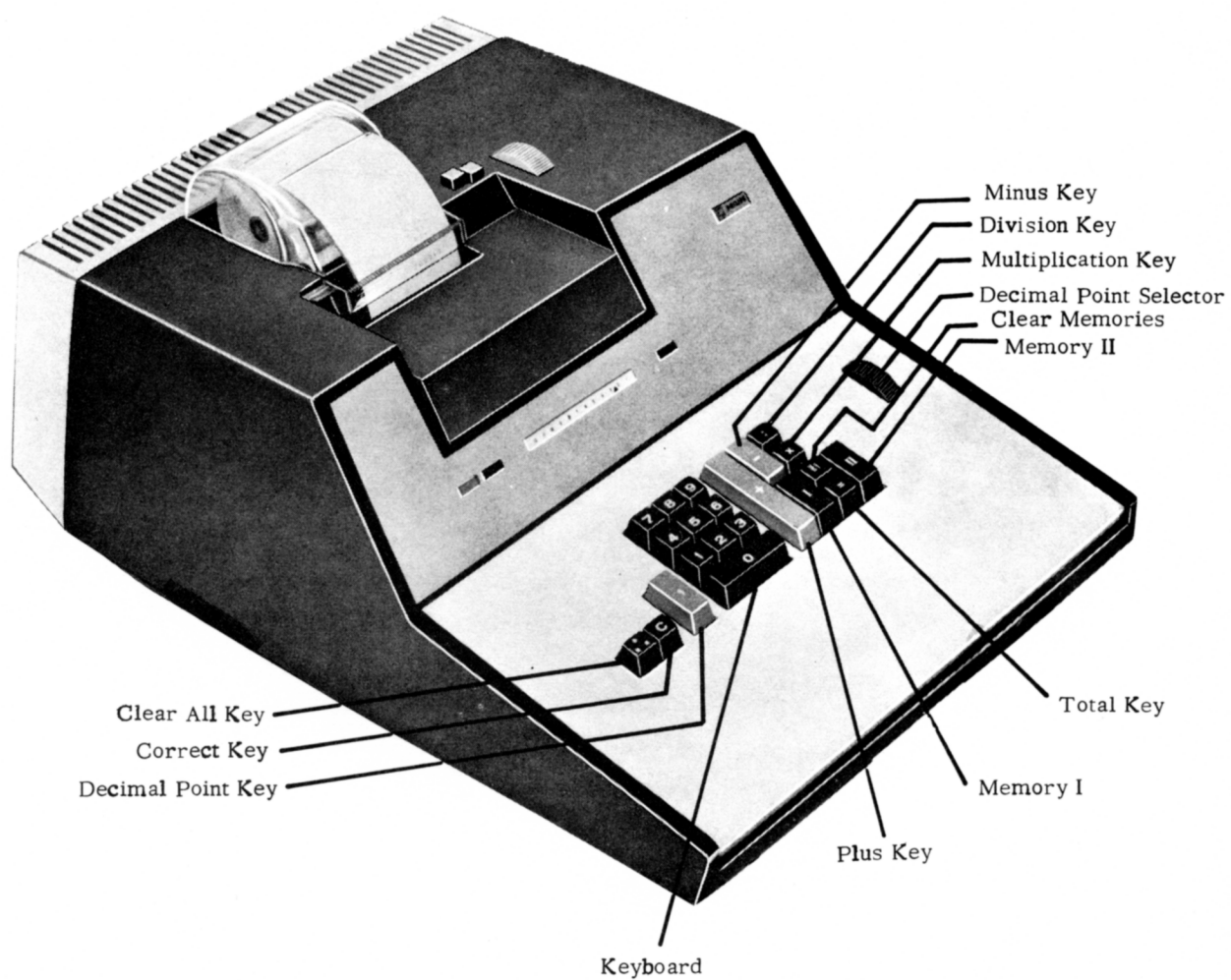
Figures are entered exactly as they are read.

The printing capacity is 23 digits as well as sign, decimal point and result identification. The machine prints at a rate of 30 characters per second and the printing is done from right to left by a drum printer, the drum being mounted behind the paper and the ribbon and hammer in front. The quality of print, however, is not up to Olivetti's usual standards. The programma 101 can perform addition, subtraction, multiplication and division. Also the square root is obtained automatically with the depression of a single key.

The price of the Olivetti Programma 101 is \$ 3200. The delivery of this machine still takes six months.

PHILIPS EL 2500

The Philips El 2500 is a printing electronic desk calculator.



The most important features of this machine are:

- Four function machine (addition, subtraction, multiplication and division)
- Entry capacity: 16 digits
- Printing capacity: 16 digits
- Storing capacity: 16 digits.
- The last printed amount is retained for further operation.
- Two storages (core memories)
- Fixed decimal point, chosen by the decimal point selector.
- Algebraic sign. Resultant answers will appear with the correct sign.
- Automatic round off device. Insignificant zeros have not to be entered.
- Overflow indicator.
- 10 function keys
- 11 key keyboard.

Up to now there was not any delivery of this machine. The price in Germany is DM 6.800. We were not impressed by the working of the keys on the keyboard. This seems to be unreliable.

WANDERER CONTI

The WANDERER CONTI is a printing electronic desk calculator. It is fully transistorized (Silicon transistors) and is developed by Nixdorf, which also built the Multitronic accounting machine.

The machine contains 3 core memories of 14 digits each. Amounts can be rounded off and digits can be truncated.

All calculating operations can be done positively and negatively (algebraically). WANDERER uses a pin feed platen, which is similar to the platen of the ordinary typewriter with the exception, however, that to the left and to the right additional cog wheels are mounted.

Printing of the WANDERER CONTI is done by means of printing wheels. (digits and characters have been mounted to movable typereels). The printing has an electronic signal back i.e. when the calculator knows that a 3 must be printed, the additional printreel turns to position 3, but does not yet print. However, this reel indicates first to the calculator that it is ready to print in position 3. Only when the calculated 3 agrees with the 3 ready to be printed, printing follows.



SPECIFICATIONS:

Capacity: 14 digits + 1 for sign + 1 for check.

Storages: 3 Ferrit core memories.
optional: 7 additional core memories.

Operating speed: Addition and subtraction: approx. 1 ms.
Multiplication and division: approx. 70 to 80 ms.

Printing capacities: 19 positions of which 14 figures and 5 symbols.

Printing speed: 200 prints a minute.

It is possible to program the machine for special problems, but this programming cannot be done by the customers.

There is a possibility to connect tape punches and tab cards, magnetic tape equipment and other output units. Input can also come from punched card readers or tape readers.

The WANDERER CONTI has a fixed decimal point, which can be chosen by a decimal point selector.

It is not possible to give a comparison with the Friden EC 130 by lack of information, while only a few machines have been installed for the time being. Our first impression, however, is that the machine has a very complicated operation (24 control keys and a 11 key keyboard). During the demonstrations the keys were not working faultless, so that in this respect the reliability of the keyboard is doubtless.

The price of the WANDERER CONTI in Germany is DM 7000.

Electronic Scientific Calculators

MATHATRONICS, INC.

Mathatronics Inc. built the electronic desk calculator MATHATRON at the selling price of \$3.490.

This machine is very complicated in operation and leaves much to be desired, primarily because of its blind operation. In the hands of skilled and dedicated users, the special sequence feature would have value in a limited market.

We do not think it necessary to give a detailed description of this machine, due to the fact that it cannot be considered a keen competitor of the Friden EC 130 and 132.

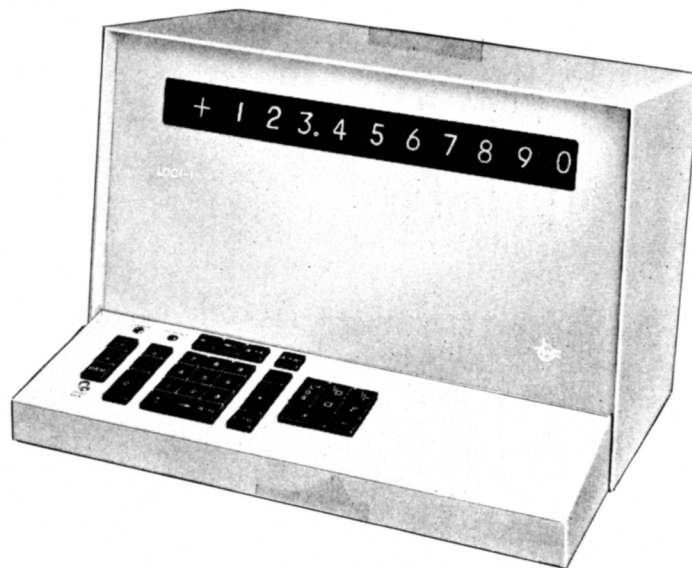
NOTE: The MATHATRON is built under licence by Electronique Marcel Daussault as EMD 8-48.



WANG LABORATORIES, INC.

Wang laboratories developed a wide range of electronic desk calculators.

LOCI-1	\$ 2750
LOCI-1a (2 storage)	3250
LOCI-1aa (4 storage)	3750
LOCI-2 (one reader, 2 storage)	\$ 4750
LOCI-2 (4 storage)	5250
LOCI-2a (16 storage)	5550
LOCI-2ab (16 storage, extra reader)	6450
LOCI-2ac (16 storage, Teletype input-output writer)	7550
LOCI-2abc (16 storage, Teletype, extra reader)	8450



Wang 300 -	\$ 1690
Wang 310 -	\$ 1895
Wang 320 -	\$ 2095

LOGarithmic Computing Instrument.

The simplest model, the LOCI 1 is a new electronic computing instrument designed to extend the personal computing powers of the scientist and the engineer. With its storage registers and keyboard it performs all of the operations found in ordinary calculators. LOCI's logarithmic principle enables it to reduce the number of steps needed for many kinds of complex calculations.

FEATURES OF LOGI-I.

Add and subtract to 10-digit precision,
0.5 milli-seconds average.

Multiply and divide to 8-digit precision,
40 milli-seconds average.

Align decimal points automatically.

Take a square root, or its reciprocal, a
square, or its reciprocal, all with
a single keystroke.*

Raise e to any power, integer or frac-
tional, in three steps.*

Raise any number to any power, integer
or fractional, in nine steps.*

Obtain silent, immediate results to all
operations.

True desk-top size.

* Performed with 8-digit precision.

These machines are impressive from a standpoint of simplicity of operation, speed, power and price. Wang Laboratories, however, is a very small company and we do not expect them to be a serious factor in the desk calculator market. Their machines are heavily slanted toward the scientific calculation field and require considerable mathematical training to understand their use. They limit the registers to 10 digits and this will be a serious handicap in the business market.

Example

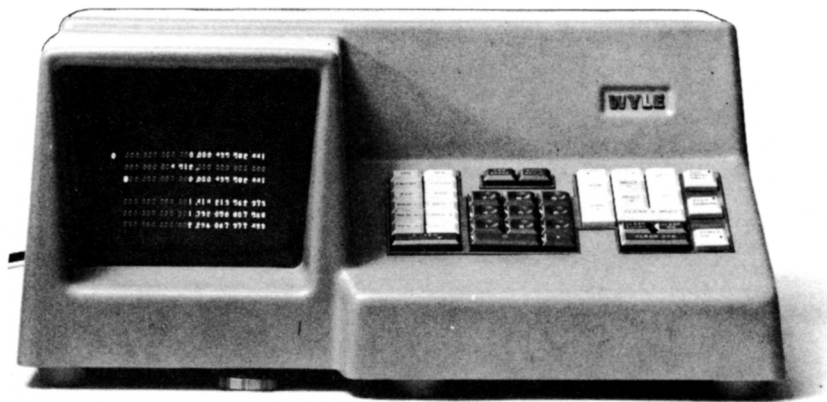
Hyperbolic sine:

$$\text{SINH}(1.25) = 1.6019 \ 19075.$$

1 [.] 2 5 [W→I] 2 [=] [ln⁻¹]
[W→A] [=] 4 [=] [ln⁻¹] [-] [A→W]

WYLE LABORATORIES PRODUCTS DIVISION

WYLE laboratories have developed a scientific electronic desk calculator the 'WYLE SCIENTIFIC' at the price of \$ 4,500. It can be connected to different in- and output equipment.



In our opinion the WYLE calculator is a perfect example of how an engineer would design a calculating machine with little understanding of market requirements. Up to now they have not been particularly successful. This machine does serve the need for a small programmable calculator, but we are sure future developments will soon make this obsolete. Therefore, we are of opinion that giving a detailed description of the machine would be a rather superfluous task.