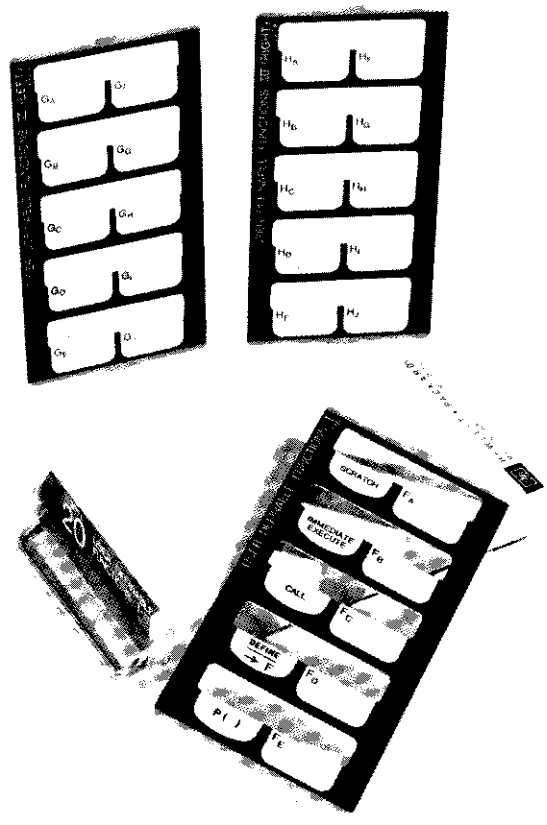


TECHNICAL DATA DECEMBER 1972



The User Definable Functions Block, Model 11222A, allows the user to define up to 25 of the keys in the left-hand key blocks of the Model 20 with special functions and subprograms. It plugs into any of the three numbered slots in the top of the Model 20 Calculator. Using this plug-in block allows up to 25 separate subprograms to exist in a protected area of the Model 20's memory at one time.

USE OF CALCULATOR MEMORY

Each subroutine and function using the definable keys is made up of lines similar to those in the mainline program. The last line is a single END statement.

Subprograms are assigned a special memory area which prevents their being changed while the mainline program is being edited or stored. With the Model 11222A in use, Fig. 1 illustrates the Model 20 memory allocations.

The P registers are not accessible by the user. They are selected by the subprogram for parameter storage, and exist only while running a subprogram using parameters.

Each section of the memory moves to accommodate program and subprogram requirements to use the minimum amount of memory. When a subprogram is scratched, the remaining subprograms and programs move up and do not leave any voids between them.

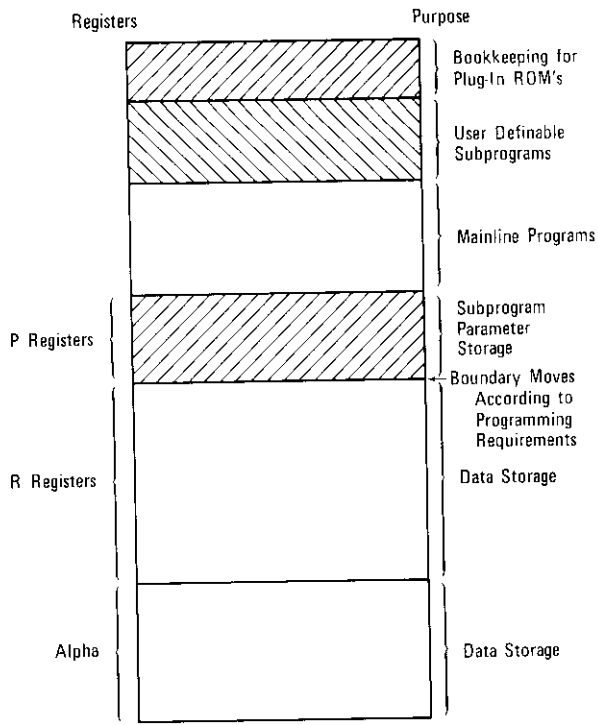


FIG. 1
MEMORY ALLOCATION

DEFINABLE KEYS

Five of the keys in the keyblock for the 11222A are control keys.



is used to erase functions or subroutines. It is also used for recording or loading subprograms.



makes any immediate execute subroutine available at the touch of a key.



is used in a program or from the keyboard to access a subprogram.



defines functions and returns the value of the function.



, the Parameter key, is used in passing parameters to functions and subroutines.



through , the other five keys, are available for defined functions or subprograms.

If no other plug-in block is present in the Model 20, an additional two blocks of ten keys each can be defined, making available up to 25 of your specialized functions. With one other plug-in block present besides the Model 11222A, 15 keys are available for defined subprograms.

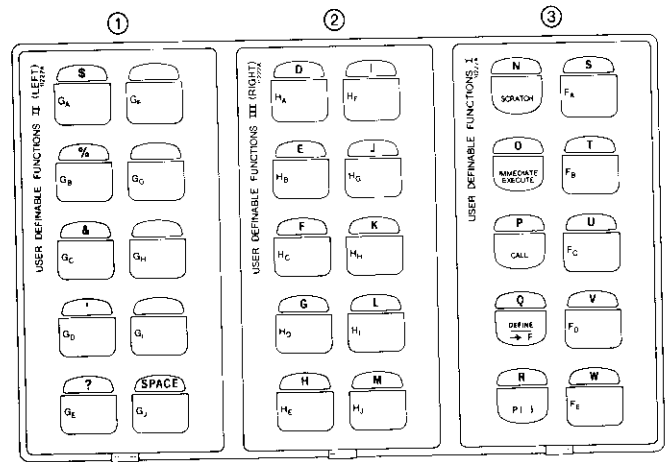


FIG. 2
KEY OVERLAYS

Three key overlays are supplied with the Model 11222A. Overlay I (FA through FE) goes over the keys directly in front of the slot holding the Model 11222A. If one other plug-in block is in the calculator, Overlay II is placed over the keys related to the empty slot. This overlay then labels keys for functions GA through GJ. If no other plug-in blocks are in the calculator besides the Model 11222A, Overlay III labels the remaining key block for functions HA through HJ; Overlay II (LEFT) is always placed to the left of Overlay III (RIGHT), regardless of which slot contains the Model 11222A.

THREE TYPES OF SUBPROGRAMS

Three types of subprograms can be used with the Model 11222A:

- Immediate execute subroutines or functions
- Subroutines with parameters
- Functions with parameters

Immediate execute subroutines are convenient for anyone to use. Any stored subprogram is available at the touch of a key, and remains in the calculator's memory for repetitive use. Immediate execute subroutines can solve a variety of repetitive problems encountered in various fields, such as impedance and transmission line characteristics for the communications engineer, and payment amounts and loan interest for the financier.

Fig. 3 shows a subprogram which quickly calculates the material required for framing a picture.

```

0:
IEX F
1:
FXD 1:ENT "LENGT
H":A,"WIDTH",BF
2:
PRT "CLASS AREA="
",ABF
3:
PRT "MOLDING LGT
H=","2A+2B:SPC 8F
4:
END F

```

FIG. 3

Subroutines with parameters are normally used when the same operation is to be done repetitively in solving a problem, but with different quantities and storage registers involved at different times. The subroutine is written in terms of unknown parameters designated as P1, P2, P3, etc., as in Fig. 4. These parameters take on specific values each time the subroutine is called. The values are transferred or "passed" to the subroutine from the main program, and become the values used in the subroutine for a specific instance when it is run. This is known as passing parameters. The parameters can be any numerical values, calculated algebraic or numerical expressions, such as $3X/Y$, or storage registers.

```

0:
"HYP "F
1:
F(P1P1+P2P2)+P3F
2:
END F

```

FIG. 4

```

0:
FXD 0:ENT A,BF
1:
CLL HYP A,B,C
2:
PRT A,B,C:SPC 2F
3:
END F

```

FIG. 5

The subroutine of Fig. 4 will use the values entered at the data entry stop in Fig. 5. The values A, B, C, become the values P1, P2, and P3 in that sequence. The ability to pass parameters greatly increases the Model 20's calculating power and the effective use of its memory, as well as increasing both its convenience and program accessibility.

The programmer can select a name or mnemonic for his subroutine, such as HYP, or SHEAR, which will identify it in mainline program listings and displays. This mnemonic is much easier to recognize than the name of the blank definable key FA, FB, etc.

Functions such as N factorial (Fig. 6a) may use unknown parameters. A function subprogram becomes a part of the calculator as long as it is needed. It is used in algebraic expressions, just as the square root key $\sqrt{\quad}$ of the basic calculator is used. For example, see program line 1 of Fig. 6b.

```

0:
"N!"P1+P2:1+P3F
1:
IF P2=0:P3+F
GTO 3F
2:
P2P3+P3:P2-1+P2:
GTO 1F
3:
END F

```

FIG. 6a

```

0:
ENT "N":A,"K":BF
1:
N!A/N!BN!(A-B)+C
F
2:
FXD 0:SPC 2:PRT
"N=","A","K=","B","C
=","CF
3:
END F

```

FIG. 6b

The Combinations program, Fig. 6b, calls the N! function three times in each solution, saving considerable memory space by using the subprogram.



GENERAL SPECIFICATIONS

Temperature: 0°C – 45°C
Power: Supplied by Model 20 Calculator
Weight: 3 oz. (85g)
Dimensions: 2.56" (6,5 cm.) wide,
4.8" (12,2 cm.) long,
0.81" (2,05 cm.) deep

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