VIVA HP-25

By George Istok (2525)

Adding a Mantissa Function

The HP-25 shows a maximum of ten digits in any display mode. In FIX, the ten digits are the number labled X if 1 X D10. If the number displayed is greater than D10 or less than one, or if the display mode is SCI or ENG, only eight digits of X and a two digit exponent can be shown. "X" is held in the micro-processor in a fifty-six bit register in binary coded decimal form. The mantissa and exponent sign are stored with X, and each digit or sign takes four bits. Thus, a register can hold fourteen four bit segements. For X = 0.000123, the register contents can be pictured like this.

0	1	2	3	0	0	0	0	0	0	0	9	0	4
1	2	3	4	5	6	7	8	9	10	11	12	13	14
M_s											e_s		

The register positions are numbered below the drawing and the mantissa and exponent sign are called out. Notice that X is left justified in the register. The decimal point positioning information is in the exponent (positions 13 and 14) and the exponent sign. The mantissa (X) is in positions 2 thru 11. The two sign bytes normally contain a zero or a nine to indicate positive or negitive.

Often, because of the display mode and the number involved, one or more digits of X are not shown. By changing the display mode or by removing the exponent, some or all of the hidden digits may be seen. The E-series calculators have a function called MANT (for MANTissa) and allow viewing of all ten X digits without altering the display mode or X itself. This feature is available on the HP-25 and can be brought out by a minor hardware addition.

To make this addition to your HP-25, you will need a small switch, about one foot of small insulated wire, and the tools required for some delicate soldering. I used a micro-switch about 1/2 inch long and 1/8 inch wide. The switch must have a flat side if you are going to glue it to the side of the case. The wire should be number 20 or smaller.

V5N4 page 22 tells how to open the case of the 25. If you have not done so befor, proceed with caution. Use the drawings in V5N5 to locate U2 and U3. Solder an eight inch piece of wire to pin 10 of U2 and route the wire from the pin side of the circuit board tc the chip side. The wire should lay in the cutout for the mounting screw closest to the charger connector run down the side of the circuit board and thru the small hole near the lower left corner (looking at the pin side of the board). A second section of wire must be soldered to pin 7 of U3. Route this wire from pin 7 to where the first wire is thru the hole in the board. Do not twist the wires together. Feed both wires thru the foot well in the case and reassemble the calculator.

Run the wires across the back of the case and up towards the SST key. Leave enough slack so the battery case can be removed. - The wires must be connected to the normally open contacts of the switch and, if you desire, glue the switch to the case. Since this is a "display function", it should go in the row of keys associated with the display. I used super-glue, but epoxy works as well and is easier to undo.

If the installation is correct, the calculator will show 0.00 when turned on, and twelve zeros after the micro-switch is pressed. BST will show 0.00 again. In use, when you want to see all ten digits of X, just press the switch. Try π in Fix 2. You should see 03141592654O. The log of 2 shows as 030102999560. Compare that with what you see normally. The first digit of the MANT display will be a zero or a nine, depending on the sign of X. A zero will always be in position twelve.

This function was discovered while searching for unsupported features in the 25. I have not labled this switch MANT because there are several other interesting displays created when the switch is pressed after a prefix key but befor the key sequence is complete. These will be covered in a future article if and when they are all sorted out. Your comments and ideas are welcome and my ego needs a boost, so write:

VIVA 25

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R/S

STILL MORE INFORMATION IN TABLES

INFORMATION IN TABLES: PART 3

I recently received my back issues of <u>65 NOTES</u>, so I haven't had a chance to write until now. In V4N8P22, Bob Patton (558) discusses methods of computing tabular information. Bob gives three approximations, and Frank Vose (60) in a follow-up in V4N9P3, adds another.

However, they both missed one approach completely. Since there are six data points, a fifth-degree polynomial can be made to fit the data exactly. The equation below yields the desired coefficients.

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 4 & 8 & 16 & 32 \\ 1 & 3 & 9 & 27 & 81 & 243 \\ 1 & 4 & 16 & 64 & 256 & 1024 \\ 1 & 5 & 25 & 125 & 625 & 3125 \\ 1 & 6 & 36 & 216 & 1296 & 7776 \end{pmatrix} \begin{pmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \end{pmatrix} = \begin{pmatrix} 1.00 \\ 1.50 \\ 1.80 \\ 2.00 \\ 2.15 \\ 2.25 \end{pmatrix}$$

Solving, we get:

$a_0 = 0.15$ $\quad a_3 = 0.0375$
$a_1 = 1.0875$ $\quad a_4 = -0.002083333333$
$a_2 = -0.2729166667$ $\quad a_5 = 0$

The fifth-degree term (a_5) comes out zero, resulting in the following fourth-degree polynomial:

$$\text{S-value} = a_0 + a_1 s + a_2 s^2 + a_3 s^3 + a_4 s^4$$

After using Horner's Rule to restructure the polynomial as

$$\text{S-value} = (((a_4 s + a_3)s + a_2)s + a_1) + a_0$$

the following HP-65 program practically writes itself:

```
 6       ENTER    RCL 3     +        x
gx>y     ENTER     +        x      RCL 0
gx≷y     RCL 4     x      RCL 1      +
g NOP     x       RCL 2     +       R/S
ENTER
```

with a_0 in R0, a_1 in R1, etc. This program takes up 21 steps and five registers (The program has deliberately been written for the HP-65 in order to maintain consistency with the previous articles). The only difference for another machine, other than the prefixes, would be the g NOP which is not required. (Even the HP-25 style conditional will work.)

For a more complete description of the polynomial-fitting process, consult any text on numerical analysis or numerical methods. (Perhaps Gary Tenzer can be persuaded to write another installment in his series Curve Fitting --- Made Easy (V5N1P29, N3P9, and N6P29) on the subject ?)

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R/S

65 NOTES

65 NOTES is for material of a general nature related to the HP-65 calculator.

I have discovered some unusual properties for the operation gx=y. which set it apart from the other operations. One lends itself to a new display technique; the other resembles Lampman split logic.

<u>Display technique</u>

If gx=y is alternated with almost any other operation that does not involve arithmetic (e.g., gNOP, ENTER, f, GTO, gLSTx, etc.) the number in the x-register is displayed as a pause function. To observe this:

```
LBL                LBL
B                  C            Key in
↑   } 10 pairs     B            1234567898
x=y }              B               EEX 19
RTN                B
                   RTN          Press C
```

The displayed number will have its digits shifted one place to the left so that the initial "1" is lost, and so is the first digit in the exponent. Both of them show up as a minus sign