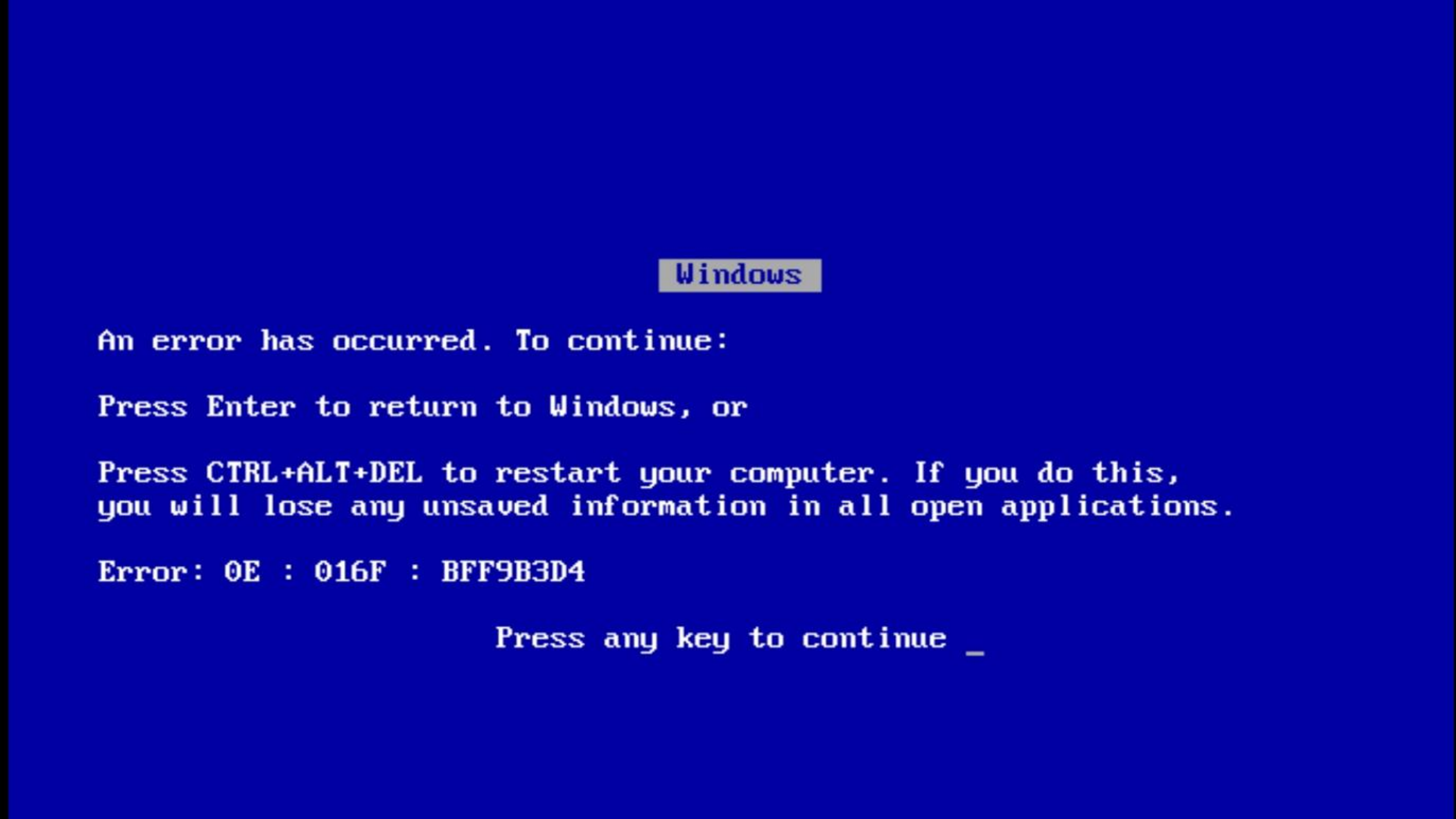

Windows
An error has occurred. To continue:
Press Enter to return to Windows, or
Press CTRL+ALT+DEL to restart your computer. If you do this,
you will lose any unsaved information in all open applications.
Error: 0E : 016F : BFF9B3D4
Press any key to continue _

****HHC2024****

HAPPY 50TH BIRTHDAY!

INTRODU
ALSO KNOW
THE
SUPER

If you had $795 to spend in 1974, this could have been yours!

$795 (1974) = $5,000 (2024)

How revolutionary was it:

- power; not just a calculator with transcendental functions (ala HP 35) but also programmable!
- ease of use for repetitive formulae. RPN key stroke programming.
- card reader expanding its memory capacity.
- most importantly, it fit into your shirt pocket!
- and popularity, as evidenced by the next slide,

by
Richard Nelson
HP-65 Users Club
2541 W. Camden Pl.
Santa Ana CA 92704

THE H-P 65: WORLD'S SMALLEST COMPUTER SYSTEM

by
Richard Nelson
HP-65 Users Club
2541 W. Camden Pl.
Santa Ana CA 92704

On Jan. 17, 1974, Hewlett-Packard announced their fourth model in a continuing series of sophisticated pocket calculators. This model, the HP-65, was unique in that it was programmable and used magnetic cards to read and write user-written programs. One of the first questions asked about the new machine was, "Is it a calculator or a computer?" There is no question that the HP-65 is the most powerful computational tool in existence for its size and weight, but in terms of an Altair 8800, Mark I or Sphere microcomputer, how does the HP-65 stack up?

Computer vs. Calculator

In the classical definition of a computer, as described by Babbage, the HP-65 is indeed a computer. The HP-65 has conditional and unconditional branching, data storage, and a memory which can be used to store a program. By today's standards a machine is often called a computer or a calculator by the task for which it is best suited. A calculator is best suited for numerical calculations, and a computer is best suited for binary or alphabetic data manipulations involving a large data base. In this sense, the HP-65 is – as it is called – a calculator.

If you are interested in computers and programming, should you consider the HP-65? Most definitely! The only negative aspect of the HP-65, compared to a typical microcomputer kit, is its cost (i.e., $795 versus about $500). If, however, you consider the microcomputer complete with an operating system and an input/output device – but built into a pocket-size package, then the HP-65 is a very competitively priced unit.

There is no doubt that the HP-65 "computer" is the easiest to get up and running. If your interests are primarily of a problem-solving nature, and a personal, portable computational and educational tool will meet your needs, the HP-65 is for you.

If your interests tend toward programming, the HP-65 is an excellent machine to learn programming upon. If you master memory limited (every computer is memory limited sooner or later) programming on the HP-65, you will have an excellent background to move up to a larger machine if you desire. There will be no problem selling a used HP-65. Just try buying one!

How Powerful is the HP-65?

The HP-65 has 100 memory steps, and 14 data registers (four in the stack) directly accessible to the user. Programs may be linked from card to card if efficient programming won't allow placing all steps on one card. Card read time is about the same as the dial "0" time on an older model telephone. Four logical comparison operations, two flags, decrement counter, convenient editing, five user-defined keys and merged codes which allow two keystrokes to occupy only one step of memory all combine to make the HP-65 so powerful that it was used to backup the on-board computer on later Apollo missions. Programs have been written for the HP-65 to perform some amazing calculations – and other tasks as well.

Hewlett-Packard has nearly 4,000 programs in their library, all available to HP-65 users. A catalog details and classifies each program. Hewlett-Packard also offers collections of programs in the form of PACs containing 40 pre-recorded cards. To date, 14 PACs are available, covering the fields of finance, mathematics, electrical, chemical and mechanical engineering, medicine, surveying, aviation and navigation.

The HP-65 can be programmed to:

a) Play Tic-tac-toe, NIM, Bagels, Craps, Ping-pong, Slot Machine, Football or Hexapawn. Some games are cybernetic – one card – and will actually learn to play a perfect game.

b) Generate 10,000 digits to test a random number routine, sort and tally the digits 0-9 to check the routine's uniformity.

c) Play word games such as Word Squares or Hangman.

d) Generate a table of prime numbers.

e) Solve up to seven simultaneous equations in seven unknowns.

f) Design a transistor amplifier circuit with all calculated values converted to EIA standard values.

g) Teach students arithmetic using teaching programs that adjust to the learning rate of the student.

h) Compute double precision products such as:

9, 753, 124, 680
x 9, 375, 168, 024 =
91,437,182,634,
021,232,320

(64-bit arithmetic is not enough precision for this number-crunching application.) The latter is an example of the type of problems in which the calculator is outstanding and the microcomputer is marginal. Try an alphabetic sort of the names of the members of your car pool and the situation is reversed.

Like all electronic "computers," someone always applies their machine in unusual ways in an attempt to solve a problem. For blind users a program has been written for the HP-65 which will produce a tone on a radio in the form of coded beeps to "spell out" the display. One user has applied a program to generate points to plot a modern art figure. In the search of trying to get 200 steps into a 100-step memory, users have even found logic that wasn't intended to be included in the instruction set. Many HP-65 users get the most from their machine by sharing their experiences through an organization established for that purpose. Most computers have users groups – for the HP-65 it is the HP-65 Users Club. ■

70

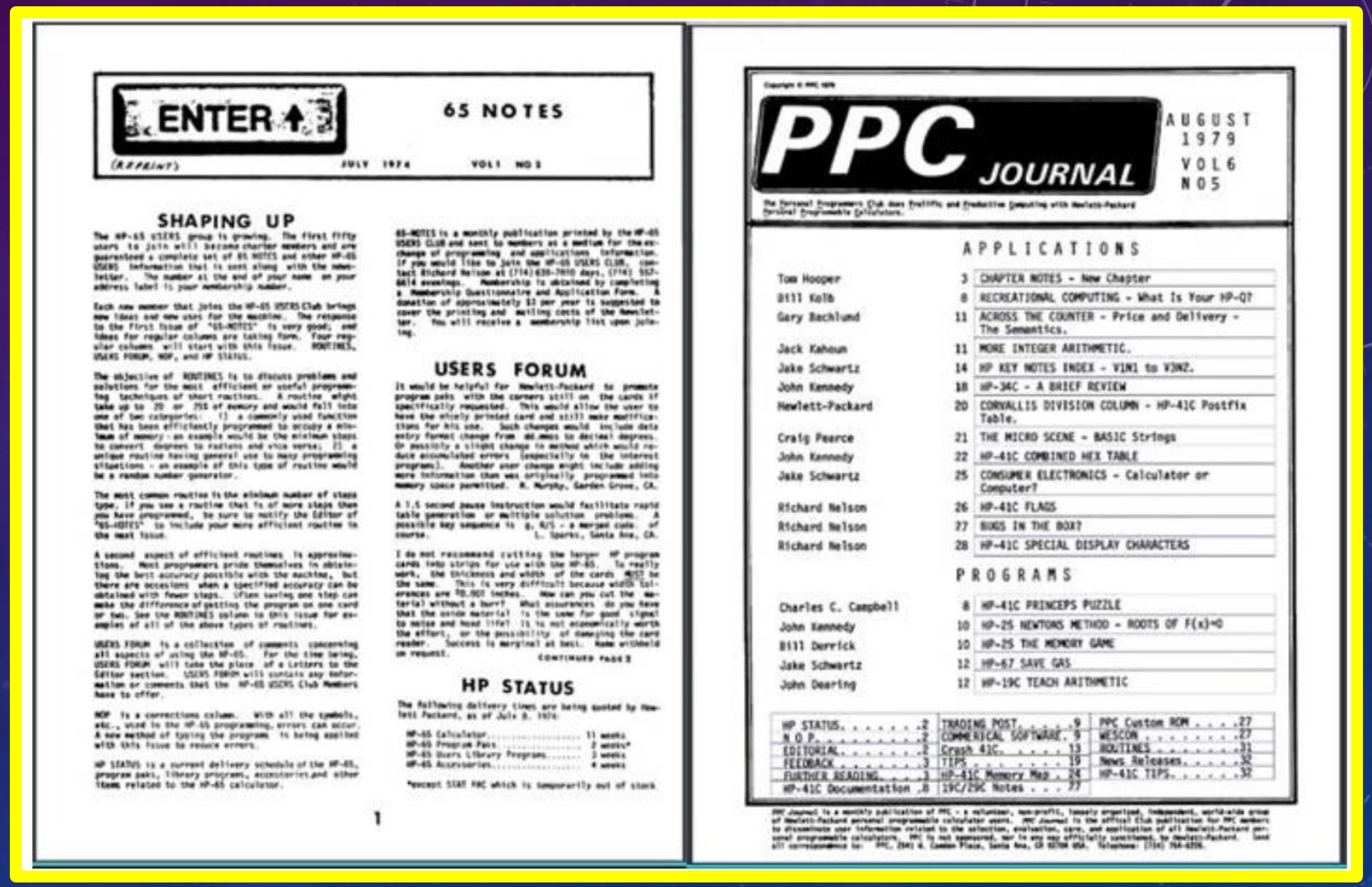
71

This is not the next slide ☺

This is the next slide ☺

Well of course there is HHC 2024, in direct line from the *65 NOTES* which was first published in 1974, followed by PPC Journal in 1978.

Giving way to all HHC's up to the present.



ENTER (REPRINT) 65 NOTES JULY 1974 VOL 1 NO 1

SHAPING UP

The HP-65 USERS group is growing. The first fifty users to join will become charter members and are guaranteed a complete set of 65 NOTES and other HP-65 USERS information that is sent along with the newsletter. The number at the end of your name on your address label is your membership number.

Each new member that joins the HP-65 USERS Club brings new ideas and new uses for the machine. The response to the first issue of "65-NOTES" is very good, and ideas for regular columns are taking form. Four regular columns will start with this issue. ROUTINES, USERS FORUM, NOP, and HP STATUS.

The objective of ROUTINES is to discuss problems and solutions for the most efficient or useful programming techniques of short routines. A routine might take up to 20 or 25% of memory and would fall into one of two categories: 1) a commonly used function that has been efficiently programmed to occupy a minimum of memory - an example would be the minimum steps to convert degrees to radians and vice versa; 2) a unique routine having general use to many programming situations - an example of this type of routine would be a random number generator.

The most common routine is the minimum number of steps type. If you see a routine that is of more steps than you have programmed, be sure to notify the Editor of "65-NOTES" to include your more efficient routine in the next issue.

A second aspect of efficient routines is approximations. Most programmers pride themselves in obtaining the best accuracy possible with the machine, but there are occasions when a specified accuracy can be obtained with fewer steps. Often saving one step can make the difference of getting the program on one card or two. See the ROUTINES column in this issue for examples of all of the above types of routines.

USERS FORUM is a collection of comments concerning all aspects of using the HP-65. For the time being, USERS FORUM will take the place of a Letters to the Editor section. USERS FORUM will contain any information or comments that the HP-65 USERS Club Members have to offer.

NOP is a corrections column. With all the symbols, etc., used in the HP-65 programming, errors can occur. A new method of typing the programs is being applied with this issue to reduce errors.

HP STATUS is a current delivery schedule of the HP-65, program pacs, library programs, accessories and other items related to the HP-65 calculator.

65-NOTES is a monthly publication printed by the HP-65 USERS CLUB and sent to members as a medium for the exchange of programming and applications information. If you would like to join the HP-65 USERS CLUB, contact Richard Nelson at (714) 639-7600 days, (714) 552-6614 evenings. Membership is obtained by completing a Membership Questionnaire and Application Form. A donation of approximately $3 per year is suggested to cover the printing and mailing costs of the Newsletter. You will receive a membership list upon joining.

USERS FORUM

It would be helpful for Hewlett-Packard to promote program pacs with the corners still on the cards if specifically requested. This would allow the user to have the wisely printed card and still make modifications for his use. Such changes would include data entry format change from .dd.mmss to decimal degrees. Or possibly a slight change to method which would reduce accumulated errors (especially to the interest programs). Another user change might include adding more information than was originally programmed into memory space permitted. R. Murphy, Garden Grove, CA.

A 1.5 second pause instruction would facilitate route table generation or multiple solution problems. A possible key sequence is g, R/S - a merged code of course. L. Sparks, Santa Ana, CA.

I do not recommend cutting the larger HP program cards into strips for use with the HP-65. To really work, the thickness and width of the cards MUST be the same. This is very difficult because width tolerances are ±0.005 inches. How can you cut the material without a burr? What assurances do you have that the cards material is the same for good signal to noise and head life? It is not economically worth the effort, or the possibility of damaging the card reader. Success is marginal at best. Name withheld on request.

CONTINUED PAGE 2

HP STATUS

The following delivery times are being quoted by Hewlett Packard, as of July 8, 1974:

HP-65 Calculator	11 weeks
HP-65 Program Pacs	2 weeks*
HP-65 Users Library Programs	3 weeks
HP-65 Accessories	4 weeks

*except STAT PAC which is temporarily out of stock

PPC JOURNAL AUGUST 1979 VOL 6 NO 5

The Personal Programmers Club does Portable and Productive Computing with Hewlett-Packard Personal Programmable Calculators.

APPLICATIONS

PROGRAMS

PPC Journal is a monthly publication of PPC - a volunteer, non-profit, loosely organized, independent, world-wide group of Hewlett-Packard personal programmable calculator users. PPC Journal is the official Club publication for PPC members to disseminate user information related to the selection, evaluation, care, and application of all Hewlett-Packard personal programmable calculators. PPC is not sponsored, nor in any way officially sanctioned, by Hewlett-Packard. Send all correspondence to: PPC, 2541 W. Camden Place, Santa Ana, CA 92704 USA. Telephone: (714) 754-6256.

Well, anything else of note? Too much to cover in this talk but we do have to mention …

NASA for one!

NASA’s 1975 logo.

HP-65 in space with Apollo-Soyuz.

The American astronauts calculated critical course-correction maneuvers on their HP-65 programmable hand-held during the rendezvous of the U.S. and Russian spacecraft.

Twenty-four minutes before the rendezvous in space, when the Apollo and Soyuz were 12 miles apart, the American astronauts corrected their course to place their spacecraft into the same orbit as the Russian craft. Twelve minutes later, they made a second positioning maneuver just prior to braking, and coasted in to linkup.

In both cases, the Apollo astronauts made the course-correction calculations on their HP-65. Had the on-board computer failed, the spacecraft not being in communication with ground stations at the time, the HP-65 would have been the only way to make all the critical calculations. Using complex programs of nearly 1000 steps written by NASA scientists and pre-recorded on magnetic program cards, the astronauts made the calculations automatically, quickly, and with ten-digit accuracy.

The HP-65 also served as a backup for Apollo's on-board computer for two earlier maneuvers. Its answers provided a confidence-boosting double-check on the coelliptic (85 mile) maneuver, and the terminal phase initiation (22 mile) maneuver, which placed Apollo on an intercept trajectory with the Russian craft.

Periodically throughout their joint mission, the Apollo astronauts also used the HP-65 to calculate how to point a high-gain antenna precisely at an orbiting satellite to assure the best possible ground communications.

The first fully programmable hand-held calculator, the HP-65 automatically steps through lengthy or repetitive calculations. This advanced instrument relieves the user of the need to remember and execute the correct sequence of keystrokes, using programs recorded 100 steps at a time on tiny magnetic cards. Each program consists of any combination of the calculator's 51 key-stroke functions with branching, logical comparison, and conditional skip instructions.

The HP-65 is priced at $795*. See it, and the rest of the HP family of professional hand-helds at quality department stores or campus bookstores. Call 800-538-7922 (in California, 800-662-9862) for the name of the retailer nearest you.

For more information on these products, write to us, Hewlett-Packard, 1504 Page Mill Road, Palo Alto, California 94304.

HEWLETT hp PACKARD

Sales and service from 172 offices in 65 countries

Mail to: Hewlett-Packard, 1504 Page Mill Road, Palo Alto, CA 94304.
Please send me further information on

( ) HP 1600A/1607A Logic State Analyzers
( ) HP-65 Hand-Held Programmable Calculator

Name _____
Company _____
Address _____
City _____ State _____ Zip _____

*Domestic USA prices only. 00548

19

Scientific American advertisement ca 1975

Tools available to the Apollo crews for the Apollo Soyuz rendezvous in 1975:

1) The Display Keyboard; the DSKY (Video included on thumb drive with the 1201 / 1202 error message.

2) Pickett slide ruler.

3) Omega Speedmaster with tachymeter and chronograph funcions.

And introducing for the first time in space, the

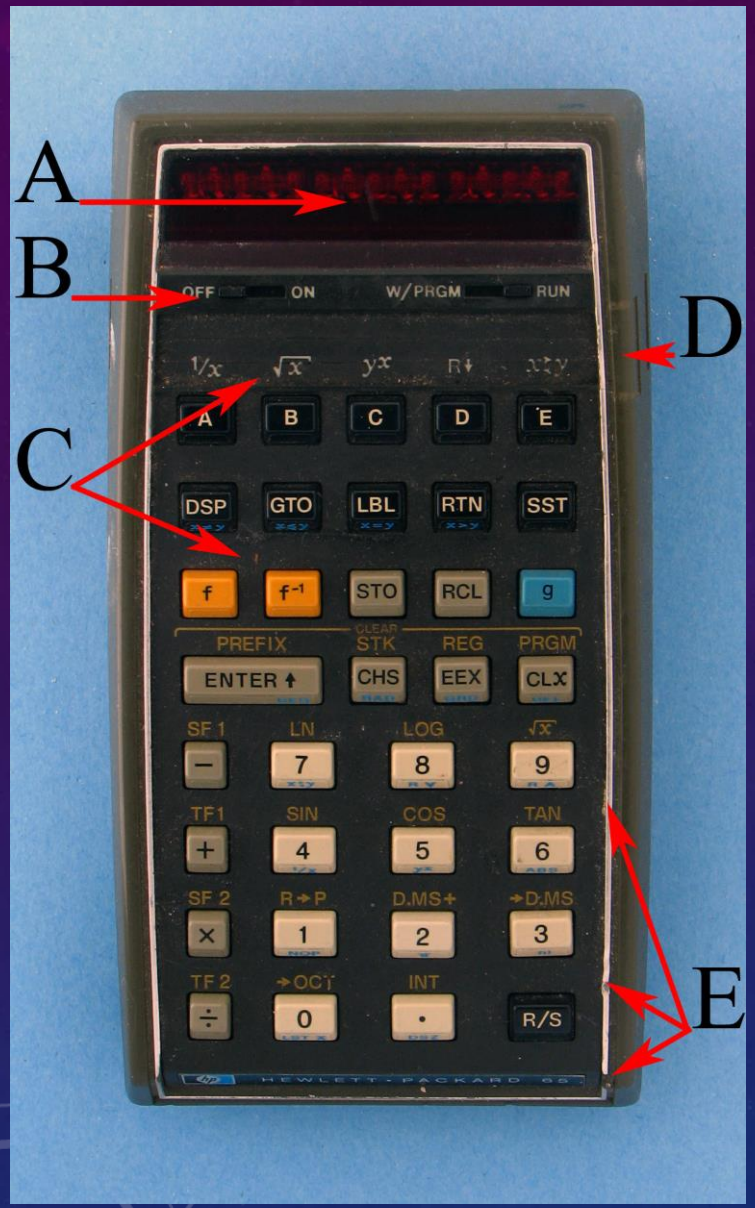
HP 65

1201; 1201; roger 1201, go flight…

But what makes it tick?

A journey from the flea market to the fully restored HP 65!

The shell.



On the left:

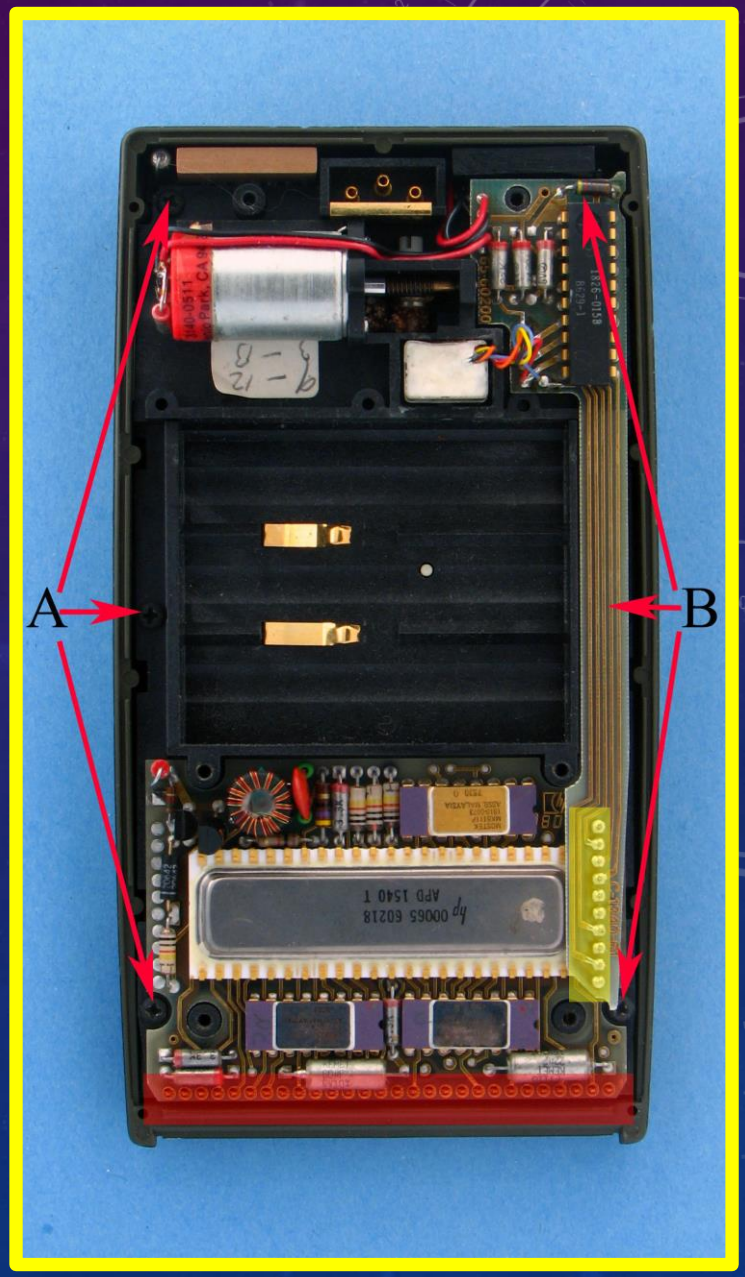
A. Crystal scratched and gouged.
B. OFF/ON intermittent.
C. Keys do not register.
D. Dent to trim.
E. Chrome dented and faded.

On the right:

A. Gouged.
B. Battery securing clip missing.
C. Another gouge.

This is just plain screwy!

Screws, screws and more screws!

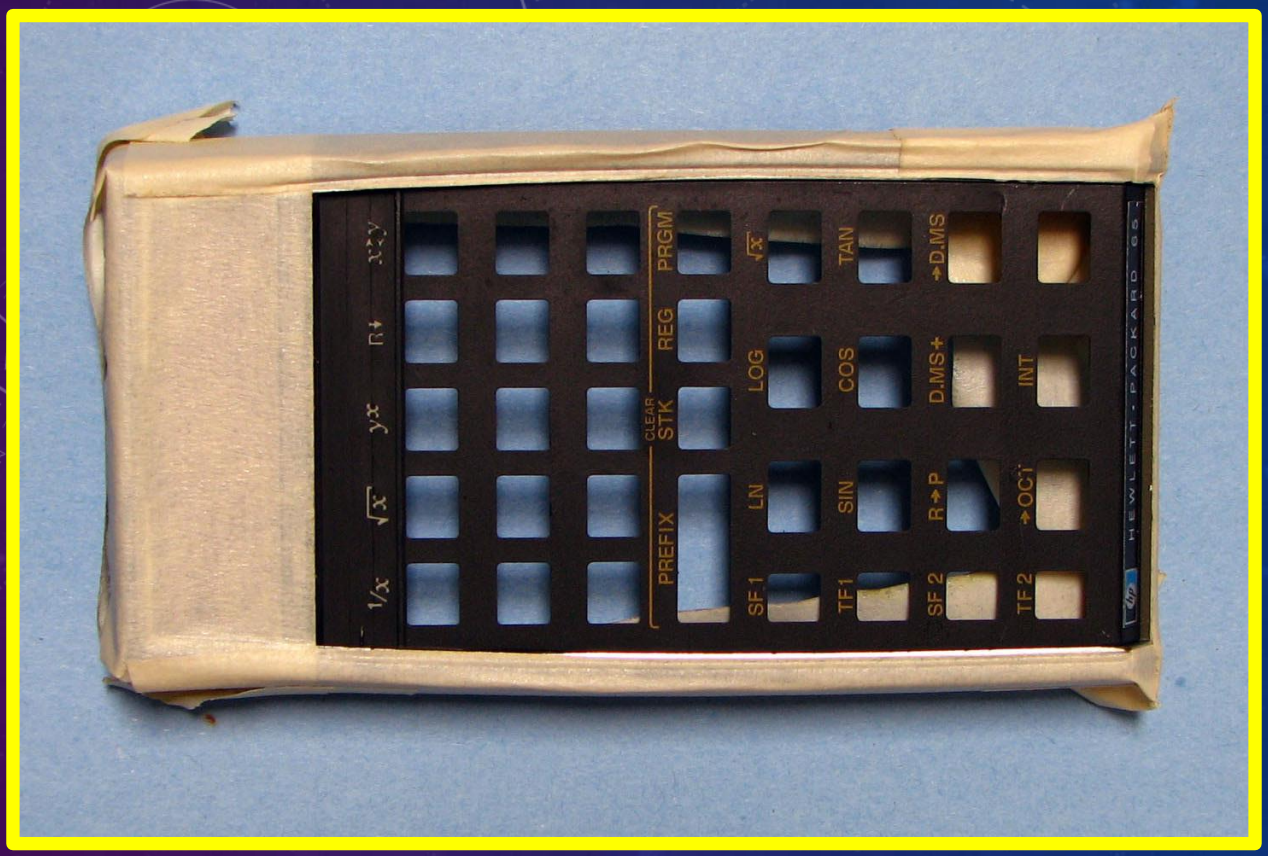


1. Keys.
2. Key frame.
3. Environmental sheet.

Exquisite manufacture, with the double injected keys, where other manufacturers used painted keys.

Top shell (bezel) silk screened and sealed in a lacquer.

Vacuum plated plastic, which is why it is so hard to cosmetically match with chrome paint.

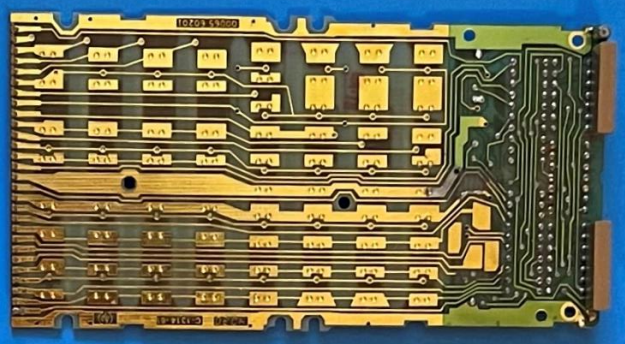


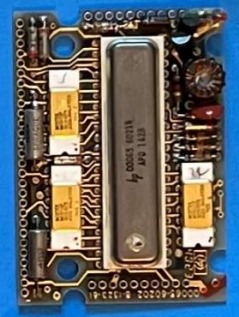
HEWLETT-PACKARD HP-65 USER AIDS

POWER ON: CLEARS REGISTERS, FLAGS; SETS DEGREES; RESETS TOP KEYS TO $1/x$, ETC.
LOAD PROGRAM FROM CARD: SET SWITCH TO RUN (W/PRGM [▒▒▒] RUN).
ALL DECIMAL POINTS LIT: LOW BATTERY. **FLASHING 0:** IMPROPER OPERATION; [CL x].
ROUND DISPLAY TO n = 0, 1, 2, ..., 9 DECIMAL PLACES: SCIENTIFIC [DSP] [n] OR FIXED NOTATION [DSP] [.] [n]. DISPLAY OVERFLOW FORCES SCIENTIFIC NOTATION.
BLUE FUNCTION: [g] FOLLOWED BY BLUE LABELLED KEY.
GOLD FUNCTION OR ITS INVERSE: [f] OR [g] FOLLOWED BY GOLD LABELLED KEY.
CLEAR PREFIX: [f] [PREFIX]. **OVERRIDE PREFIX:** PRESS NEW PREFIX.
MINUTES AND SECONDS: 2 DIGITS EACH, e.g., 3°6′5″ IS 3.0605.
REGISTER R_0 CHANGED: [f] [R↓P], [g] [R↓P], TRIG FUNCTIONS, AND COMPARISON TESTS.
STOP PROGRAM: [R/S]. **CONTINUE AGAIN:** [R/S].
SET ANGLE MODE: [g] [DEG], [g] [RAD], OR [g] [GRD]. STAYS SET UNTIL CHANGED.
STACK: ALL ENTRIES INCLUDING [RCL] [n] AND [g] [LST x] RAISE STACK EXCEPT THOSE FOLLOWING [ENTER↑] OR [CL x].
COORDINATE CONVERSION: [f] [R↓P]: y, θ → Y; x, r → X. [g] [R↓P]: θ, y → Y; r, x → X.
EXAMPLE: $(3 \times 4 + 5! \times \tan 7°)/9^3 = 0.04$.
[3] [ENTER↑] [4] [×] [5] [g] [n!] [7] [f] [TAN] [×] [+] [9] [ENTER↑] [3] [g] [y^x] [÷]

MADE IN U.S.A.. PATENT PENDING. 3.75V 500mW

The little bits.





The bigger bits.

The card reader.

A. Card reader control PCA.

B. Card read/write head connecting wires.

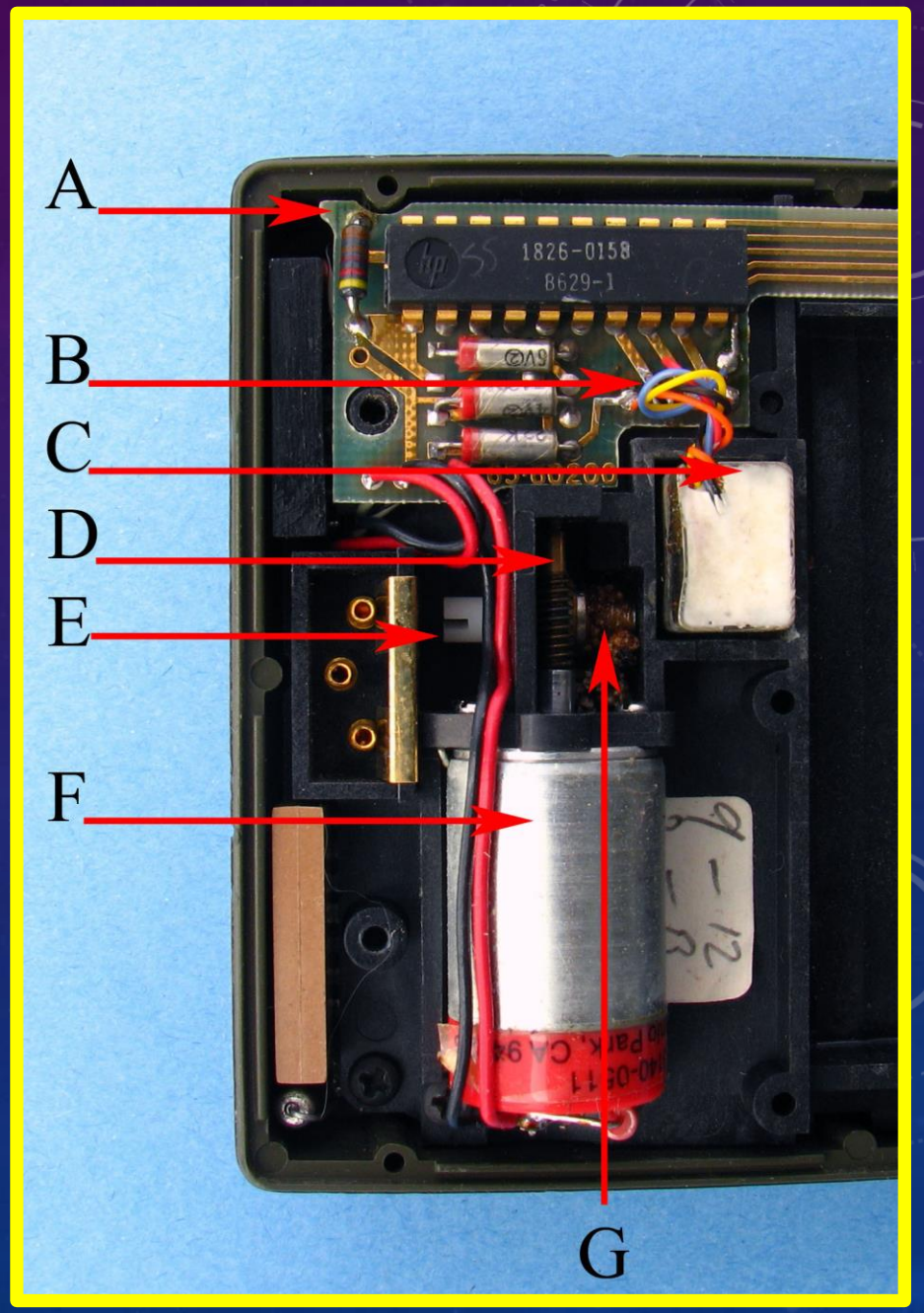
C. Card read/write head.

D. Worm gear.

E. Eccentric screw.

F. Card reader drive motor.

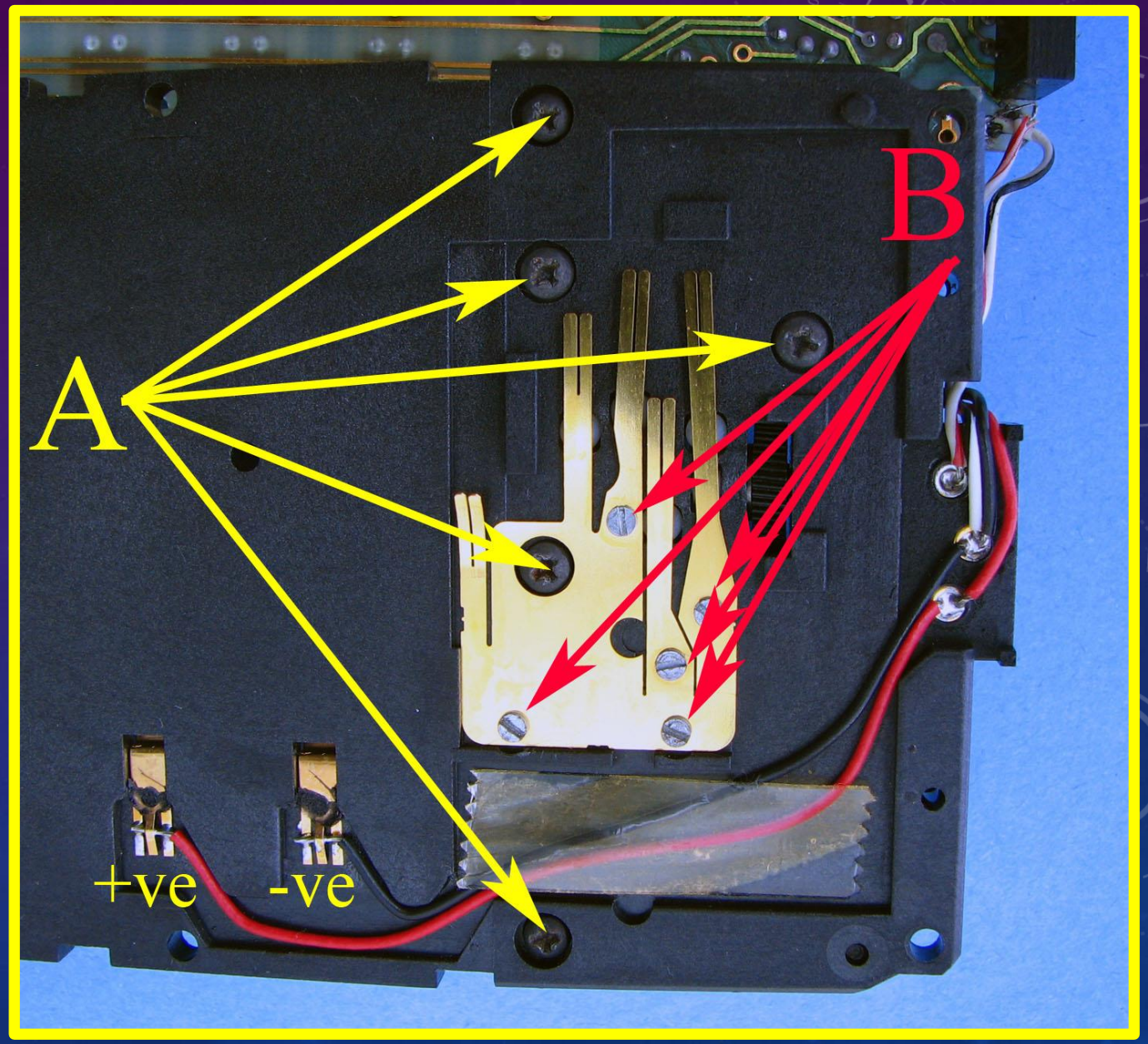
G. The problematic pinch roller.



And still more SCREWS!

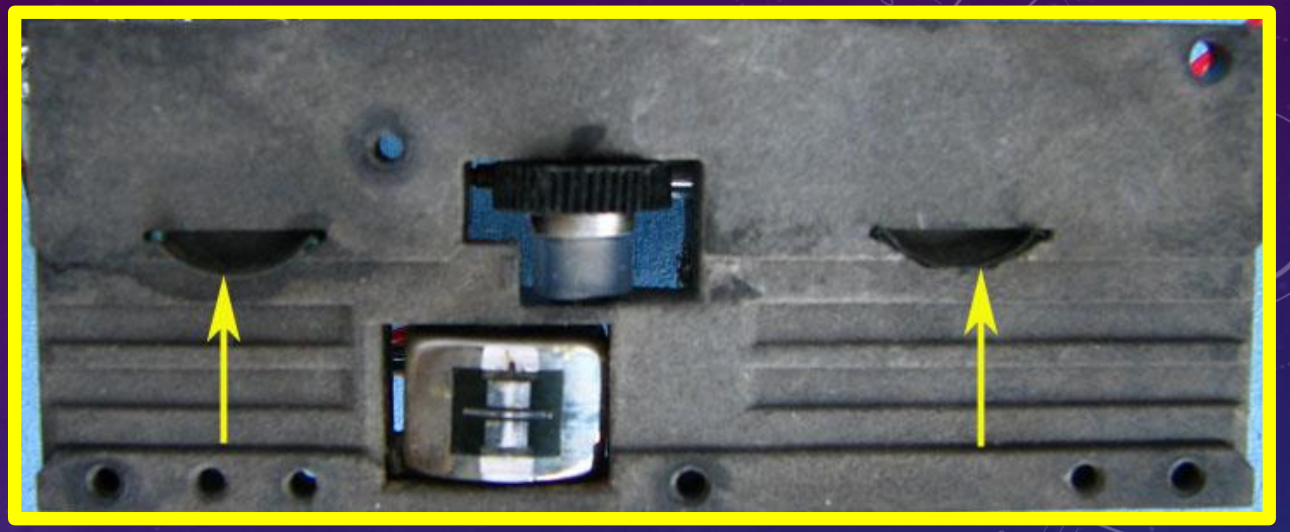
RED ARROWS!

- Do not tamper with these screw parts, as removal of the screws will determining card entry, exit, and/or clipped

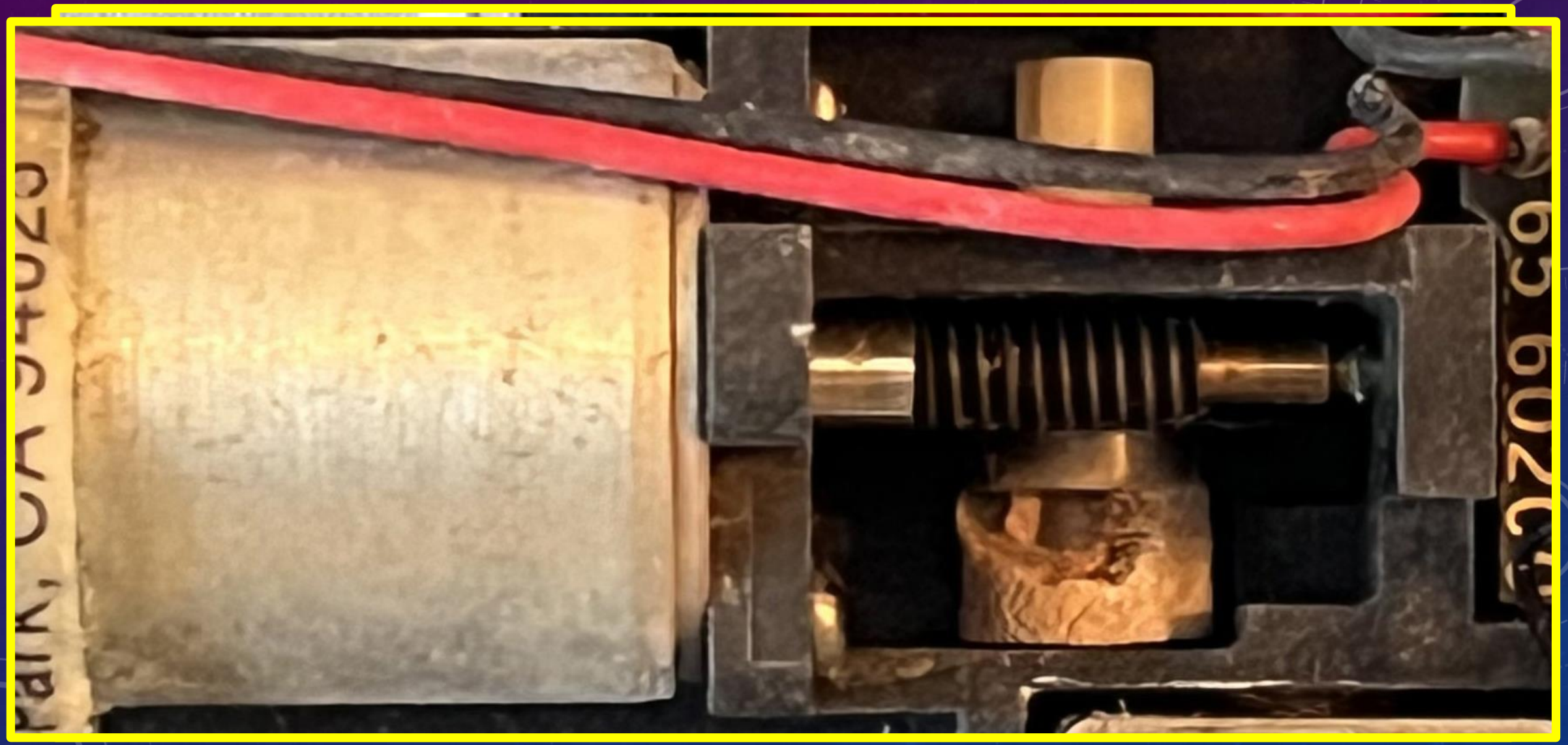


The various parts:

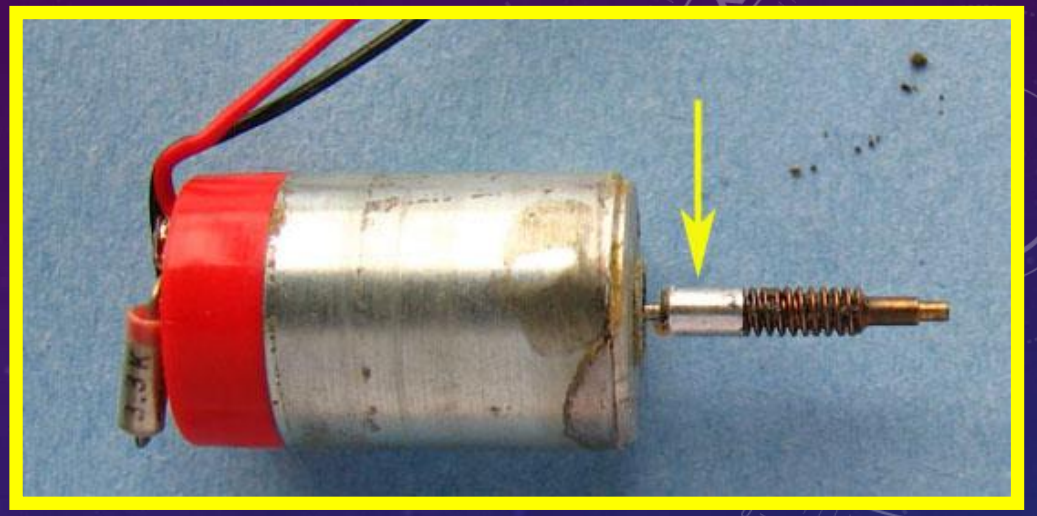
- Two bronze clips,
- roller,
- balls,
- pinch roller and
- eccentric screw.



Why perform this type of surgery?



Card reader motor.



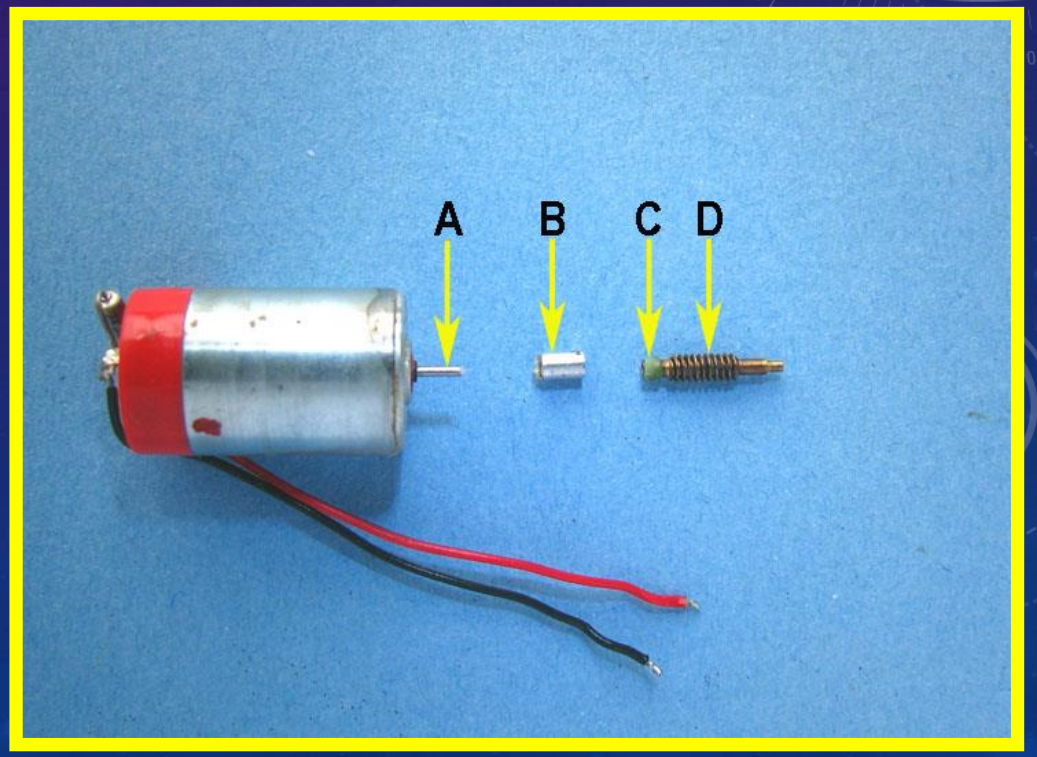
The card reader motor assembly:

A. Motor pivot (axle),

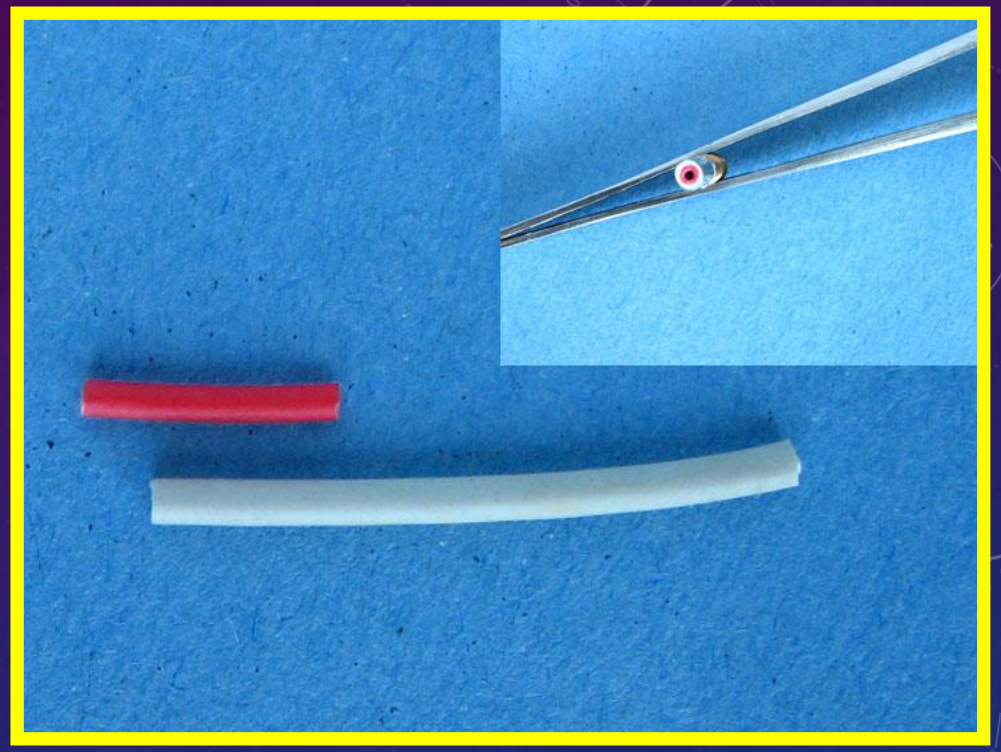
B. Aluminum sleeve (tube),

C. Rubber couple, (not a clutch).

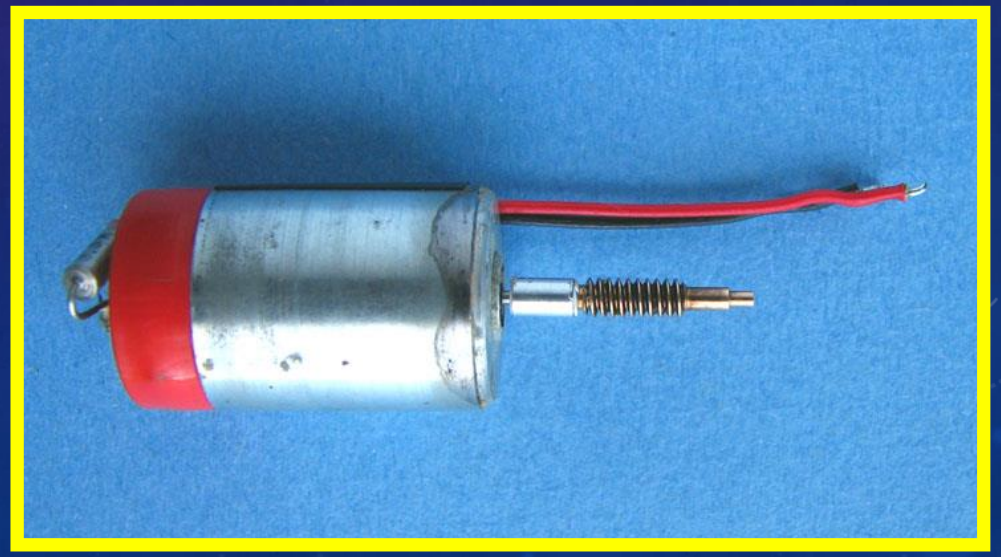
D. Bronze worm gear.



A fix (there are a few) that tries to emulate the original function. It is a couple between the motor pivot (axle) and the worm gear. Both have different outer diameters. Also may dampen any vibration generated by the motor to enable better card read/write function.



This fix uses wire insulation with two differing inner diameters and outer diameters. The diameters chosen tightly fit the motor and worm gear pivots and each other.



The HP 65 cerebrum

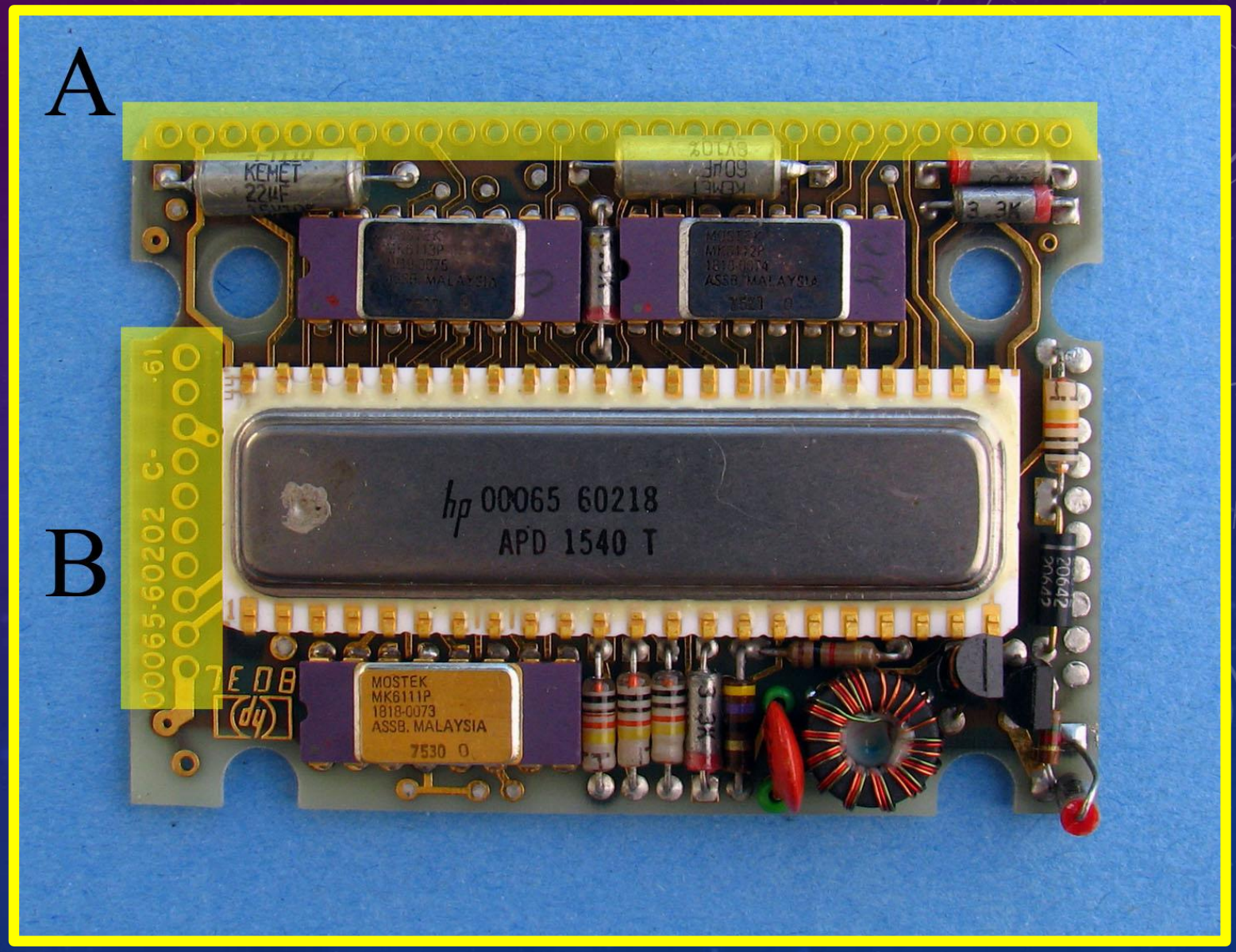
The BRAINS!

Uhmmm, BRAINS good!

Connections:

A. Keyboard/PCA interface.

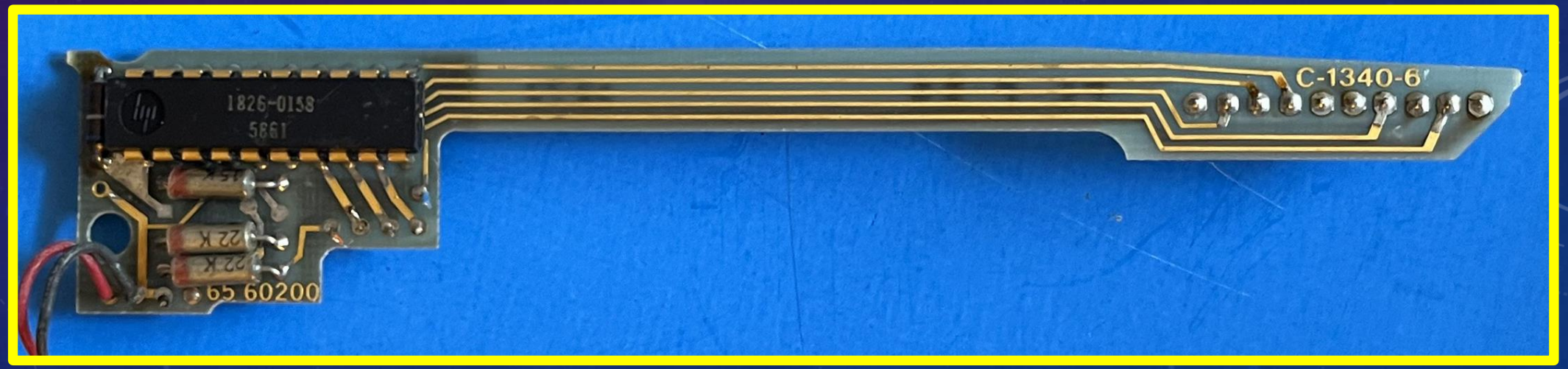
B. Card reader/PCA interface.



uuuuuuhhhhmmm brains uuuuuhhhhhhhmmmm.

The HP 65 cerebellum

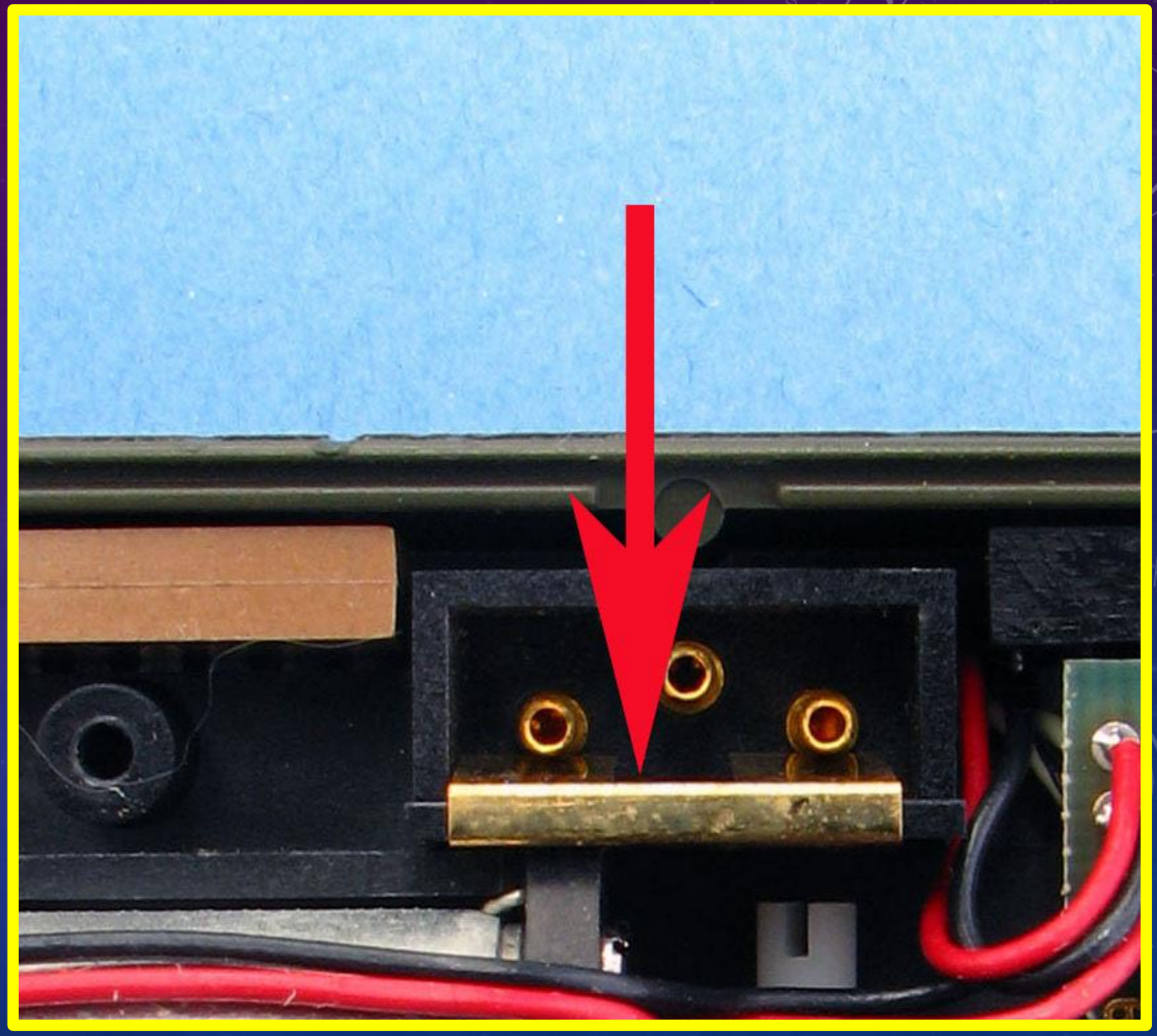
Card read/write PCA



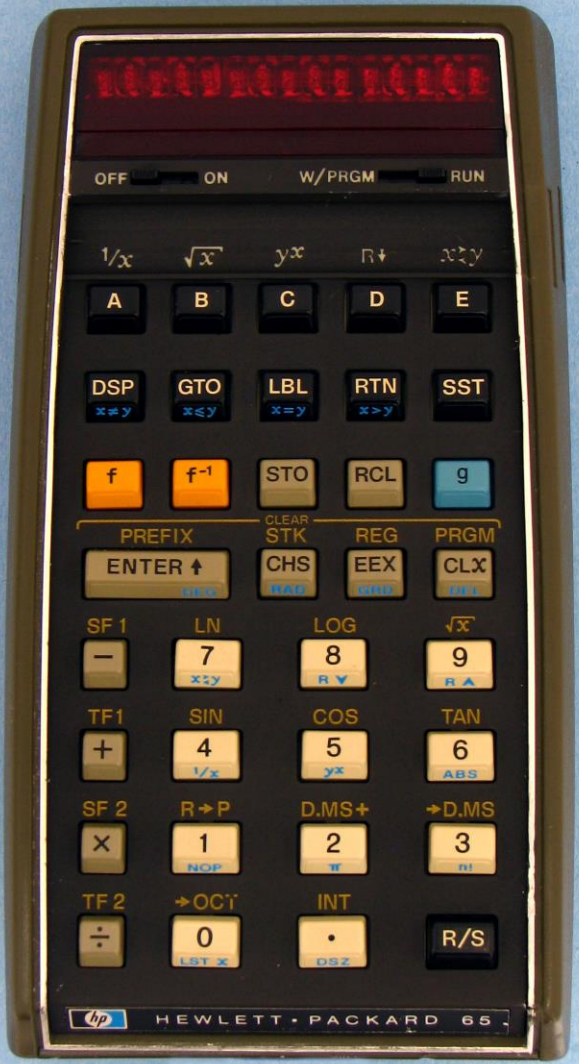
One more thing with the classics…

This clip is required on the Classics and the one Woodstock, the HP 67, to function.

The clip shorts the extreme left and right terminals. When testing the calculator outside the case, these terminals must be shorted with clips.



And after assembly, all those screws and components, the flattened label, semi gloss acrylic spray varnish, chrome paint....



Some interesting appendices…

From Eric Smith's wonderful compendium of useful facts and wisdom.

Who decides that there are 10 hot dogs in a pack but only 8 buns?

I am with them. Same group, different department.

- **00065-60218** ***MAIN PCA***
  - hybrid ARC, CTC, RAM, program store, clock driver.
- **1810-0146** ***KEYBOARD PCA***
  - Quad inductor hybrid.
- **1810-0147** ***KEYBOARD PCA***
  - Quad inductor hybrid.
- **1818-0073** ***MAIN PCA***
  - ROM.
- **1818-0074** ***MAIN PCA***
  - ROM.
- **1818-0075** ***MAIN PCA***
  - ROM.
- **1826-0158** ***CARD READER PCA***
  - card reader sense amplifier.

DIAGNOSTIC 1

Code	Keys
31	f
43	REG
21	DSP
09	9
07	7
31	f
07	LN
31	f
08	LOG
31	f
09	√x
31	f
04	SIN
31	f
05	COS
31	f
06	TAN
32	f^{-1}
04	SIN
35	g
04	1/x
32	f^{-1}
05	COS
32	f^{-1}
06	TAN
35	g
04	1/x
32	f^{-1}
07	LN
32	f^{-1}
08	LOG
32	f^{-1}
09	√x
35 00	g LST X
31	f

Code	Keys
01	R→P
31	f
03	→D.MS
32	f^{-1}
01	R→P
32	f^{-1}
03	→D.MS
31	f
02	D.MS+
02	2
42	CHS
35	g
06	ABS
35	g
05	Y^x
35	g
02	π
81	÷
31	f
83	INT
31	f
00	→OCT
05	5
35	g
03	n!
51	-
32	f^{-1}
00	→OCT
33 08	STO 8
35	g
83	DSZ
34 08	RCL 8
32	f^{-1}
02	D.MS+
35 00	g LST X

Code	Keys
33	STO
61	+
06	6
34 06	RCL 6
61	+
71	x
09	9
42	CHS
83	.
04	4
08	8
00	0
04	4
07	7
00	0
02	2
03	3
00	0
43	EEX
42	CHS
09	9
02	2
71	x
32	f^{-1}
83	INT
35 08	g R↓
35 07	g X↔Y
35 09	g R↑
35 01	g NOP
84	R/S

DIAGNOSTIC 2

Code	Keys
11	A
35 21	g x≠y
00	0
84	R/S
31	f
61	TF 1
01	1
84	R/S
31	f
81	TF 2
02	2
84	R/S
12	B
35 22	g x≤y
03	3
84	R/S
32	f^{-1}
61	TF 1
04	4
84	R/S
32	f^{-1}
81	TF 2
05	5
84	R/S
13	C
35 23	g x=y
06	6
84	R/S
31	f
61	TF 1
07	7
84	R/S
85	f
81	TF 2
08	8

Code	Keys
84	R/S
14	D
35 24	g x>y
09	9
84	R/S
15	E
05	5
42	CHS
83	.
00	0
09	9
02	2
09	9
05	5
08	8
01	1
07	7
08	8
43	EEX
42	CHS
08	8
06	6
31	f
06	TAN
21	DSP
09	9
21	DSP
09	9
84	R/S
23	LBL
11	A
5	5
33 08	STO 8
31	f
42	STK

Code	Keys
24	RTN
23	LBL
12	B
34 08	RCL 8
31	f
51	SF 1
31	f
71	SF 2
22	GTO
15	E
23	LBL
13	C
32	f^{-1}
51	SF 1
32	f^{-1}
71	SF 2
22	GTO
15	E
23	LBL
14	D
44	CLX
23	LBL
15	E
35	g
83	DSZ
35 01	g NOP
24	RTN
01	1
42	CHS
84	R/S

From the Hewlett Packard HP 65 Standards Pac

USER DIAGNOSTIC PROGRAM I:

Results: from the HP 65 Standards Pack manual.

DISPLAY	CALCULATOR MALFUNCTION
0	g, x≠y
1	f, TF 1 (with flag clear)
2	f, TF 2 (With flag clear)
3	g, x≤y
4	f^{-1}, TF 1 (with flag set)
5	f^{-1}, TF 2 (with flag set)
6	g, x=y
7	f^{-1}, SF 1
8	f^{-1}, SF 2
9	g, x>y
-1	DSZ

User Diagnostic Program 1 tests various functions and is designed to stop with a single numerical value displayed which indicates the malfunction.

User Diagnostic Program 2 must be singled stepped (SST) through, and the display must be checked with the following chart to determine which function is failing.

USER DIAGNOSTIC PROGRAM II:

Results: from the HP 65 Standards Pack manual.

DISPLAY	CALCULATOR FUNCTION CHECKED
0.00	
0.000000000 00	DSP 9
7.	
7.000000000 00	Lift Enable
1.945910149 00	f, LN
2.891227832 -01	f, LOG
5.377013885 -01	f, $\sqrt{x}$
9.384521785 -03	f, SIN
9.999999866 -01	f, COS
1.745506463 -02	f, TAN
1.000152325 00	f^{-1}, SIN
9.998476982 -01	g, $^1/_x$
9.999900006 -01	f^{-1}, COS
4.499971354 01	f^{-1}, TAN
2.222236368 -02	g, $^1/_x$
1.022471120 00	f^{-1}, LN, (e^x)
1.053103655 01	f^{-1}, LOG (10^x)
1.109027308 02	f^{-1}, $\sqrt{x}$ (x^2)
1.053103655 01	g, LST X

From the Hewlett Packard HP 65 Standards Pac

Repair tips:

1. Missing PCA traces due to battery leakage and corrosion may become visible after the vinegar bath. In fact, be aware, the calculator may be functional prior to the restoration but refuse to work after. A weak trace due to corrosion may disintegrate completely after the vinegar bath. It is a risk, but ultimately the corrosion would have resulted in a failed trace. To repair the traces:

    a. Apply gold, silver or conductive material trace paint to reconnect any traces that were destroyed by corrosion.
    b. Another method: follow one section of the trace to a solder point or component, attach a fine insulated wire. Locate a solder point on the other side of the missing trace and attach the wire there thus *bridging* the missing portion and completing the circuit.

2. Removing and replacing faulty integrated circuits:

    a. Once an inoperative IC has been located refer to **appendix 1** where there is a list of ICs found in the HP 65. Some of these chips are also found in other HP classic calculators which can be sourced as replacements. I came across an HP 70 with a bad RAM chip. The same chip is found in the more common HP 45. The HP 45 chip was successfully transplanted into the HP 70.[7] A de-soldering iron with built in de-solder bulb is an excellent aid for IC removal.

3. Ghosting LEDs may not be an IC driver fault but a fault of the LED block. The LED display of the HP 65 is three blocks of five digits. The author used an LED block from an unrepairable HP 80 to repair ghosting on an HP 67 block. Other LED faults occur due to bad solder contacts. Before replacing IC driver chips, renew all the solder points on the ICs and the LED blocks.

A compendium of anecdotal, experience derived practical tips designed to aid in the restoration of all things.

4. Electrolytic capacitors are filled with oil and age over time. Most of these calculators are over 40 and so aging capacitors may affect the function. Especially in continuous memory calculators such as the 41C series. Consider replacing after cleaning and confirming all contacts soldered or non-soldered are functional.

5. Consider a kluge (work around) to solve problems. The dampening couple repair is a kluge. Another example is a mobile telephone battery connection to replace missing battery spring contacts. Bridging missing traces with wire and etc. Build up a supply of parts. Don't turn down an opportunity to purchase a dead HP calculator at the local boot sale or flea market.

6. Most problems associated with these calculators involve battery damage through leakage or outgassing. Outgassing damage may not leave any visible damage but may destroy traces within the integrated circuits.

7. If you possess sophisticated electronic equipment, then diagnosing bad components should be easy. This manual will get you into the calculator allowing analysis.

8. Aftermarket products:

    a. Back labels, battery packs, battery covers and etc. are occasionally offered for sale on eBay.
    b. Another source for hardware is a 3D printer or site that offers 3D printing to your specification.
    c. As of the writing of this article, Bernhard Emes of Panamatik has produced an ACT replacement chip which work in the Woodstock calculators as well as the HP 67 which is a Woodstock.[8] Bernhard also has a stock of Woodstock LED blocks available. They are aftermarket but fit well in the Woodstock family.
    d. The HP 41C series now have a main PCA replacement known as the HP 41CL created by Monte Dalrymple.[8]

Static electricity precautions:

While working with circuit boards and integrated circuits, caution must be maintained with regard to static electricity. Try to minimize contact with the chips and handle the circuit boards by their edges. Working in a kitchen, workshop or any other non-carpeted room with a ground available would be ideal. Place the material on a grounding sheet which is also grounded and touching the sheet before the circuits is one way to defeat the problem. Use a grounding strap; a simple grounding strap can be two clips and a wire. Clip one end to a ground and the other to your watch or ID bracelet.

Notes about soapy water solution, vinegar, alcohol and electronic enhancers:

Cleaning with any type of solvent may be required but should be kept to a minimum. Contaminants can impact electronics by slowly dissolving fine traces or connections, changing resistance between components and/or interfering with mechanical contacts. All of which interfere with the proper function of the calculator. Avoid introducing any liquid into an LED block.

Each of the above solvents will remove various foreign contaminants. Sticky water soluble residue can be removed with soapy water followed by a rinse. White vinegar (an extremely mild acid) will remove copper sulphate precipitate caused by outgassing or leaky batteries.

Soapy water solution:

A mild solution consisting of a few drops of a commercial liquid dish detergent to a cup of lukewarm water. Used to remove any water soluble sticky detritus from circuits, *PCAs* shells and keys.

- Use this for the circuit boards and internal components.
- May be used on the *keyboard bezel*.
- Do not use a harsh brush on the *keyboard bezel*.
- Do not rub the *keyboard bezel* during cleaning.

Precautions and cleaning solutions.

To clean or not to clean, that is the question!

Is it more noble to restore or to leave it dirty and permanently aggravate your OCD.

Vinegar:

White vinegar, not malt, that's for the fish and chips.

- Use this on the circuit boards and internal components.
- Do not use on the *keyboard bezel*.

Anhydrous alcohol:

Anhydrous alcohol is preferred or any isopropanol with low water content. The alcohol is used for oily residues and is used as a final rinse prior to drying and assembly.

- Use this on the circuit boards and internal components.
- Do not use on the *keyboard bezel*.

Contact enhancers:

There are many products which enhance the restoration process. They coat and preserve traces, lubricate contacts and prevent corrosion and in some cases reverse corrosion damage. These would be applied on dry surfaces after any contamination is removed using the above solvents.

Which treatment:

The calculator may not require all of the above treatments. Pick the one that applies to your situation but always finish with a water rinse followed by anhydrous alcohol rinse and thorough drying.

Worst case scenario:

The worst case scenario includes battery precipitate, water soluble dirt and oil based residues. The suggested order for treatment follows:

1. Soapy water solution wash.
2. Rinse with water.
3. Vinegar wash or soak.
4. Rinse with water.
5. Anhydrous alcohol wash.
6. Thorough drying.
7. Contact enhancer or preserver.

- Hair dryer: label removal
- Sharp knife: label removal.
- Spoon: smoothing label.
- Tweezers.
- Small Phillips screw driver.
- An even smaller Phillips or fine slotted screwdriver.
- Grounding sheet.
- Clear vinyl ID holder or similar product: label.
- Adhesive remover: label, do not use on plastic case.
- Soft polishing cloth: LED lens.
- Soft brush, similar to a make-up brush: *keyboard bezel*.
- Long bristled artist brush: *PCA* cleaning.
- Soft toothbrush: *PCA* cleaning.
- Fibre glass pen or pencil eraser: contact cleaning.
- Lacquer thinner: scratches and engravings.
- Liquid dish detergent.
- White vinegar.
- Anhydrous alcohol.
- Masking tape.
- *for plastic matte clear coat.*
- Chrome paint pen: chrome trim.
- Plastic polish: LED lens.
- 1000 and 2000 grit sandpaper: *keyboard PCA* contacts, LED lens.
- Paper strips: *keyboard PCA* domed contacts.
- Fine pointed solder iron.
- De-soldering iron.
- Solder.
- Flux.
- Silicon tubing and O-ring measurements:
  - Inner diameter: 2.5mm
  - Outer diameter: 5.5mm
- Multi-meter or Continuity tester: trace damage.
- Magnifying glass: trace damage.
- Industrial razor blades: heat stakes.

A list of tools, equipment and sundry that can be found around the house, attic, basement, back yard and car boot (trunk for you Americans) which will aid in the pursuit of perfection and act as a salve for you OCD.

Use low heat. It should not be too hot to handle.

REFERENCES

Hicks, D: 2024. HPMUSEUM. Collectanea of all things Hewlett Packard and more!
The Museum of HP Calculators (hpmuseum.org)

Mier-Jedrzejowicz, W.A.C . 2013: A Guide to HP Handheld Calculators and Computers. Standalone Books. 5th edition.

Nelson, R. 1975: The HP 65: Worlds Smallest Computer System. BYTE magazine 1975 page 70.

Nelson, R. 2021. HHC2021
What we started

Quickfall, G. 2016: HP 65 Restoration. DATAFILE V35 special issue.
HPCC Datafile

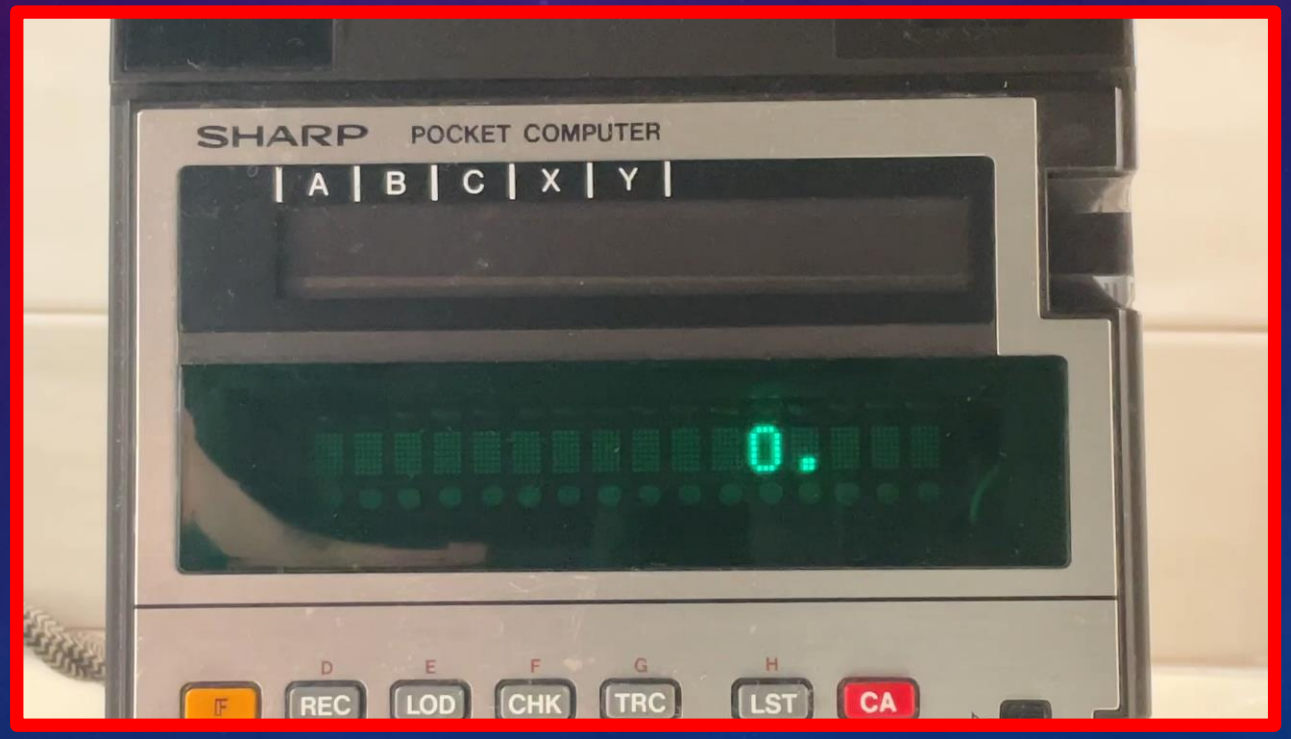
Quickfall, G. To be announce: A Guide to the Restoration of Hewlett Packard Calculators. Unpublished.

Rechlin, E. 2024: A compendium of articles, information and a guide to all things HP!
hpcalc.org - HP Calculator Archive

Schwarz, J. 2023: An incredible archival project by are very own professor of photography and preservation.
PAHHC Handheld Electronics Page

Smith, E. 2024: Brouhaha! Eric's Eccentric Emporium of Egregiously Effervescent Effluvium, Etc.
Eric's Eccentric Emporium of Egregiously Effervescent Effluvium, Etc. (brouhaha.com)


DATA MAY BE LOST


SHARP
POCKET COMPUTER
A B C X Y
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REC
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CHK
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CA