AccessionIndex: TCD-SCSS-T.20121208.029
Accession Date: 8-Dec-2012
Accession By: TCD Dept.Mathematics
Object name: HP9820A Programmable Calculator
Vintage: c.1972
Synopsis: Electronic programmable scientific calculator, HP's first algebraic calculator. S/N: 1144A02907

Description:
This electronic programmable scientific calculator was HP's first algebraic calculator, although it was HP's third calculator (both their first calculator [HP9100, 1968], and their second [HP9810, 1971] employed reverse Polish notation). It was developed by HP's Loveland division (Calculator Products Division). They were marketed as "Calculators" to make purchasing easier, as at the time some companies had different procedures for purchasing "Computers". They and their like can be considered as a precursor to personal computers (PCs).

It was integrated circuit based, with a 16-character 5x7 dot-matrix LED display, magnetic card reader/writer for offline program and data storage, a 16-column thermal dot-matrix printer, and four rear slots for interface boards. I/O Expanders that added nine slots were also available.

It was a fully algebraic calculator with parentheses, precedence and even implied multiplication. (e.g. 2AB meant 2 times A times B.) The calculator displayed the expression as entered on a single line alphanumeric LED display (which showed 16 characters and scrolled as needed) and evaluated it when the EXECUTE key was pressed. Data was stored in registers labelled A, B, C, X, Y, and Z as well as the numbered registers R0-R172 (up to R428 with optional memory installed).

The HP9820A user's programmes were written in a language later named high performance language (HPL). Fundamentally it is a simple five-function calculator (add, subtract, multiply, divide, and square root), but the functionality could be expanded using plug-in 'ROM blocks' plugged into any of three slots behind the display. ROM blocks came with metal overlays to label corresponding sets of unlabelled keys. Two such blocks were installed: 'Mathematics 11221A' and 'User Definable Functions I-III 11222A').

Internally it used reverse Polish notation (RPN), involving the use of a 'stack'. The calculator compiled each algebraic expression into an RPN-style sequence, and only the RPN version was stored. As the user finished each line, it was compiled, and the source was discarded. If the user wanted to edit a line, it was automatically uncompiled back into algebraic and displayed.

The HP9820A has a 4-bit serial processor on four TTL-based boards with medium-scale integrated circuit logic that plug into an internal serial bus. Firmware is stored in custom HP LSI ROMs. Intel 1103 1Kbit static RAMs provide storage for program and registers. Additional RAM could be added for programs or data, either factory or field installed up to a maximum of 3432 bytes. Data was stored in an internal binary floating-point numeric representation that provides ten digits of accuracy.

The unit in this collection was donated by TCD Dept.Mathematics.

Accession Index	Object with Identification
TCD-SCSS-T.20121208.029.01	HP9820A Programmable Calculator. S/N: 1144A02907.
TCD-SCSS-T.20121208.029.02	HP9820A Mathematics 11221A ROM block.
TCD-SCSS-T.20121208.029.03	HP9820A User Definable Functions I-III 11222A ROM block.

Figure 1: HP9820A Programmable Calculator three-quarter view

Figure 2: HP9820A Programmable Calculator keyboard front right view

Figure 3: HP9820A Programmable Calculator keyboard front left view

Figure 4: HP9820A Programmable Calculator left ROM block

Figure 5: HP9820A Programmable Calculator right ROM block

Figure 6: HP9820A Programmable Calculator left ROM block manufacturing label

Figure 7: HP9820A Programmable Calculator right ROM block manufacturing label

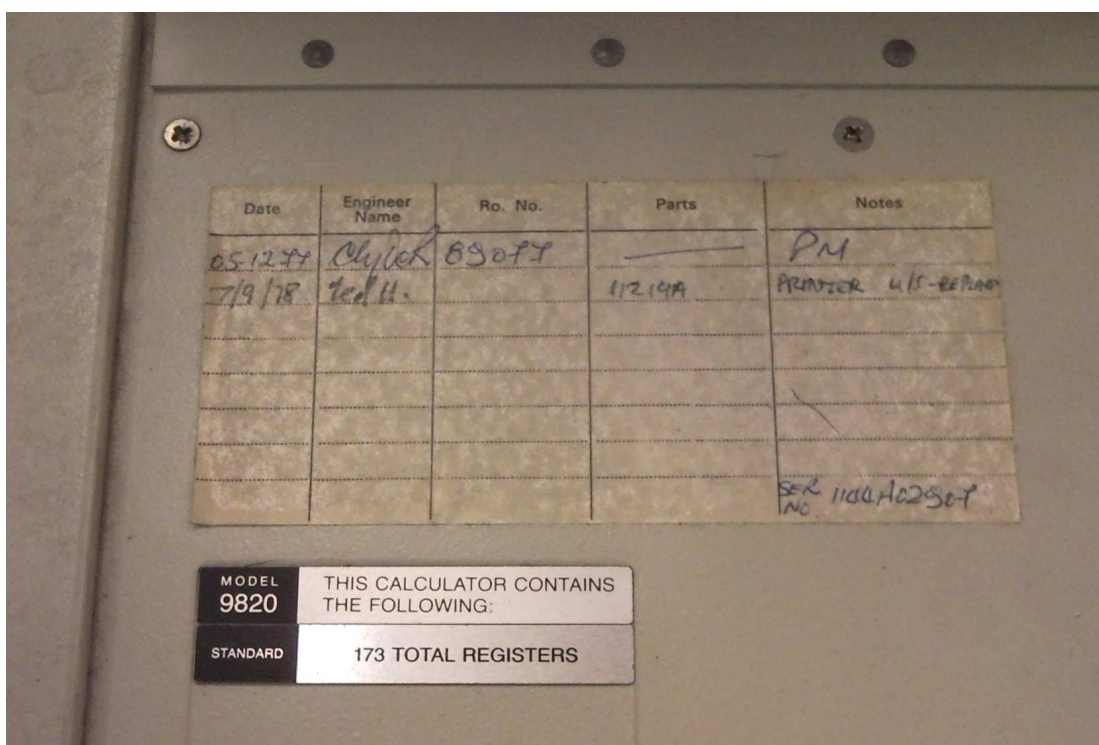*Figure 8: HP9820A Programmable Calculator showing right top cover lifted*

Figure 9: HP9820A Programmable Calculator upgrade log

→ → → → NOTE IDENTIFICATION → → → →
(condensed)

Notes indicate that an illegal or improper _____ has been attempted.

a. If occurring during keyboard operation:

PRESS: [BACK]

to recall line. See list below.

b. If occurring during program execution, program _____

PRESS: [RECALL]

to recall incorrect line. See list below.

Note	Meaning	Example or Procedure
01	Syntax Error	*f* −, E, 2, GTO or END while in an Enter statement. To exit Enter statement: PRESS: [STOP]
02	Non-valid argument or parameter	r(−5), SPC 16
03	Extra "("	—
04	Extra ")"	—
05	R register address out of range.	R(−2), R4300
06	Improper store.	R→3
07	Return not preceded by Go To Sub	—
08	Improper branching statement.	GTO 52 in a 30 line program.
09	Line being written is too long or subroutines nested too deeply.	—
10	Numeric overflow/-underflow.	7/0 , .1/E99
11	Non-defined key	Use of half-keys without ROM installed and not in a quote field.
12	Memory exceeded	Storing of present line exceeds memory.
13	Attempt to record on a protected magnetic card.	—
14	Magnetic card reader operation incomplete.	PRESS: [EXECUTE] insert new card.
15	Configuration error.	Present program recorded with a different ROM configuration. To ignore, PRESS: [CLEAR]
16	Printer out of paper	To ignore, PRESS: [CLEAR]

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Note	Meaning	Example or Procedure
20	Peripheral select code not in range: 1 ≤ S.C. ≤ 15	WRT 22,R1
21	Coordinates of plotter axes outside range of plot.	SCL 0,10,0,10; AXE −10,01
22	Incorrect or non-valid format statement.	FMT "HP"1 TYP N1
24	Attempt to scratch a defined subprogram during program execution.	Program Execution of: Line 0: SCR FR1

→ → → → → INITIALIZATION → → → → →

At turn-on, or when [ERASE] is pressed, the following conditions are established.

1. All programmable memory is cleared.
2. All flags are cleared.
3. NORMAL mode is set.
4. Plug-in ROM's are initialized, as applicable, i.e., degrees set, etc.
5. FLOAT 9 is set.
6. The display and line 0 contain the following information.

0: END ⊢

7. The program line counter is set to line zero.

→ → → → → HIERARCHY → → → → →

Mathematical operations will be performed in the following order when evaluating a mathematical expression.

First: Functions (sin a, ln b)
Exponentiation ($a \uparrow b$)
Unary Minus ($-b$)
Implied Multiply (ab)
Explicit Multiply, Division ($a \times b$, a/b)
Addition, Subtraction, Unary Plus ($a + b$, $a - b$, $+a$)
Last: Relational Operators (=, ≠, >, ≤)

The order of operations within an expression (for each level of nesting) is from left to right for each level of the hierarchy.

→ → → → → → → → → → → → →

Local Hewlett-Packard
Sales and Service Office: _____

_____

Phone Number: _____
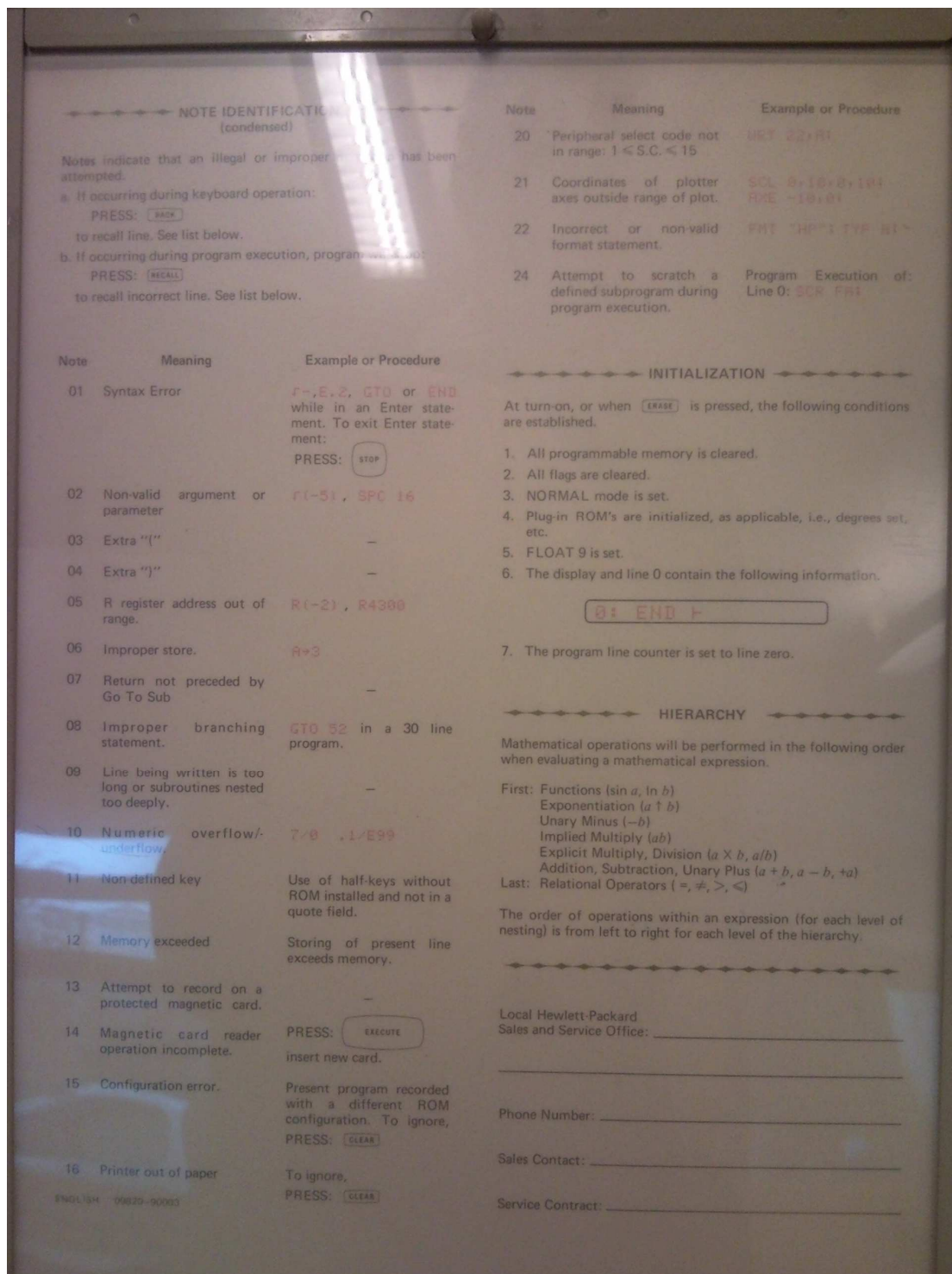
Sales Contact: _____

Service Contract: _____

Figure 10: HP9820A Programmable Calculator user guide inside right top cover

Figure 11: HP9820A Programmable Calculator rear view

Figure 12: HP9820A Programmable Calculator left rear closeup,
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Figure 13: HP9820A Programmable Calculator right rear closeup