Trivia on HP Handheld Calculators and PDAs

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Stichting POCKET

Pre-release version

Let's face it, writing is hell
William Styron (1925-)

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Acknowledgements

Finally my second book is in a state that I regard it good enough to release to the public. It took me four years to come to this final stage, hence the quote that you can find on the first page.

My thanks go out to Włodek Mier-Jędrzejowicz who always has been a great help and a fantastic inspiration and to Joseph K. Horn who really was enthusiastic about this book when I showed him a first draft a couple of years ago.

As it is not cheap to publish a book on your own, it is rewarding to do so. I still have "loads" of copies from my first book so I certainly did not break even. I think that it is very important that information such as can be found in this book, should be collected and made available to those that are interested.

Should you enjoy reading the book as much as I had writing it, the effort can be regarded as very worthwhile according to me.

Marc Staps
Tilburg, The Netherlands
April 2000

The Answer to the Great Question of … Life, the Universe and Everything … [is]
Forty-two
Douglas Adam (1952-)

From "The Hitch Hiker's Guide to the Galaxy" - 1979

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Introduction

Some people might wonder why someone would write a book like this. The answer is simple: I wanted to have written two books before I got 30 years old ☺.

The real reason is that I don't want interesting information to be lost. Just look at the fabulous job that Craig Finseth did with his HPDATAbase. This has been a renowned source of information over the years.

The information in this book is compiled from a lot of different sources. This includes articles, club magazines, the Internet but also information obtained directly from developers on HP calculators.

I understand that the information can be quite overwhelming and that you can call this hardly easy reading. Anyhow I hope that the reader finds at least some of the information entertaining.

Most of the interesting information is from before the HP-48GX time and earlier because lately nothing really exciting is happening. We have not seen any "revolutionary" improvement in calculator hardware but only in its software. That's why I feel that currently for example mobile phones are so interesting for so-called techno-freaks. I hope I'm not offending anyone with this term; I just use the term to illustrate what I'm trying to explain. When high-tech calculators were the rage almost every techno-freak was involved with them. Now it seems that mobile phones have taken over the role that calculators had in the past.
Mobile phones are changing so fast in terms of (proprietary) hardware and software that is becomes very interesting for the average techno-freak. To me a brand like Ericsson gives me the same enthusiastic feeling that HP give me in the mid-eighties. The fact that this all is happening is apparent in the number of magazines, user groups, web-based newsgroups.

Interesting for this time is that almost all of the new advanced calculators are available as emulators. From HP it is made available, for others it can be obtained. I mean with this that HP now legally provides the user with a ROM image even if you do not own the particular calculator (currently only for the HP 49G, not for the HP-48SX and HP 48GX). This is not true for most of TI's (Texas Instruments) calculators (still HP's main competitor in the high-end market) so you either have to own the calculator or you obtain the ROM image through other means which is illegal.

Because an emulator is available for the HP 49G I still have not bought one. I am not a student anymore and at my work and home I do have access to a desktop PC or notebook so I can "always" run the HP 49G emulator. The physical HP 49G box does not excite me (my opinion is that the colour scheme is something for the youth, not the professional user) enough to try and get a HP 49G. Because if I really wanted to acquire a HP 49G I really have to search for it because it is nearly impossible to get it from a shop (I live in The Netherlands) that sells office supplies without the shop having to order the HP 49G. This is even besides the price, which is very high in comparison to the US price. In comparison I just have to go to a nearby local Dixons (major Electronics retailer in Europe) shop (10 minutes away) and I can by a TI-89 (not a bad calculator considering that Diana Byrne was involved with its development) off the shelf for a reasonable price (of course higher than the equivalent US price). There is really no good reason for this considerable price difference when you take in consideration that all these calculators are made in Asia. As for the availability of the HP 49G and other HP calculators I can only say that in my personal perspective it is a lost opportunity.

As this is a pre-release edition of the book I would appreciate it if you could mail me your comments to mstaps@crosswinds.net If you want to ask me some questions about the book or something else please use the above email address. I really appreciate your assistance to make the information more complete than it already is.

Model Number	HP-9100A
Release date:	Published in the HP Journal of September 1968
Known prototypes:	2

Known developers:

David S. Cochran	did internal programming for the HP-9100A and designed the algorithms for the HP-35;
Richard E. Monnier	section leader for the HP-9100A;
Thomas E. Osborne	developed a floating-point calculator at his own firm called Logic Design Co. upon which the HP-9100A was based. He received $ 25 for each machine that used his algorithm. He became a consultant at HP where he looked at copyright infringement done by HP's competition;
Chung C. Tung	involved in the design.

At HP in 1965 a couple of consultants showed a clear way to do both floating-point multiplication and transcendal functions (like sines and logarithms) in one machine.
One of those consultants was Thomas Osborne who, in 1964, had built a prototype electronic calculator in his own free time. This machine consisted of some 2264 diodes and 208 transistors and carried the name "Green Machine" because of its colour. The Smithsonian possesses the "Green Machine"; one of the two known HP-9100A prototypes is owned by the National Museum of American History Collections.
The other known prototype is owned by the HP Calculator Museum in The Netherlands.

The main visual difference between the prototypes and the production model is that a round knob can be found to the right of the display. I think that the knob's use is to select the number of digits, a function which can be done by a wheel to the right of the keyboard with the production model.

The HP-9100A is if I may believe the stories a combination of the "Green Machine", a HP-2114A and a HP-1300. Integrating these took around 2.5 years. The HP-2114A was an instrument controller and the HP-1300 the display graphics system for that. The HP-2114A concept was developed by Kay Magleby at Stanford while he was getting a Ph. D.. The HP-1300 was developed by Chuck House who later became Corporate Engineering Director at HP.

The test tools which were developed for the HP-9100A eventually became the 1600 series logic analysers. Chuck House was also involved in this project.

In November 66, HP introduced it first "computer", the HP-2116A which is in fact an instrument controller (4 Kbits magnetic core memory as in HP-9100A/B). I assume that the HP-2116A is like a HP-2114A but with more features. Both the HP-2114B and HP-2116B are descendants of the HP-2116A. The 2116A was the basis (time-line 2116A-2100A-21MX-1000) for the well known HP-1000 Computer which used the RTE-IV operating system.

Dr. Van Allen (1914-) relied on a HP-9100A and its optional plotter to study the feasibility of using a gravity slingshot around Jupiter to allow Pioneer 11 to intercept Saturn. Pioneer 11 was retasked and arrived at Saturn before Voyager 1.

The HP-9100A got more memory (256 bytes of RAM instead of 128) with the HP-9100B and was succeeded by the 98X0 series with the more industrial HP-9810 in 1971. The HP-9810 had (5 k-11 Kbytes ROM, 908-2924 RAM) semiconductor memory as opposed to the 9100's magnetic core memory (4 Kbytes ROM) and used a proprietary 8 MHz processor from HP.
After this HP introduced other advanced desktop calculators in the 98X0 range but those had less in common with the HP-9100's. After this they introduced the 98X5 series (HP 16-bit NMOS II/LSI based), 98X6 series (Motorola 32-bit 68000 based). The high-end calculator line ended with the introduction of the HP model 9000 series 500 in 1983 which are computer workstations.

The HP-9100 faced competition from Wang, which later became active in office automation in 1973 when it became a manufacturer of mini-computers.
The HP-9100 series was discontinued in late 1971, early 1972.

Model number: HP-35
Known prototypes: 2
Described known varieties: 16

Description of known prototypes:

1 One with gold trimmings;
2 One with silver trimmings which came into production. This prototype had black instead of white lettering on the blue keys.

Description of known varieties:

1 Small hole next to the ON key;
2 HP logo printed inside battery compartment; serial number, starting with 1143A, imprinted between the rubber feet on the back in 1 mm high digits. This variety was only made for inside use by HP employees;
3 As 3 except that the calculators were made for a customer company;
4 As 3 except that the serial number was imprinted in 3 mm high digits. This variety was the first one to go on general sale to the public;
5 No hole next to the ON key;
6 Serial number, starting with 1143A, printed inside battery compartment;
7 Serial number, starting with 1230A, printed inside battery compartment;
8 Raised dot on the 5 key;
9 Serial number, starting with 1143S, printed inside battery compartment;
10 Hewlett Packard 35 label instead of Hewlett Packard label;
11 All keys printed on. These keys were rectangular instead of square buttons. Trigonometry key in black instead of dark grey;
12 ON and OFF key moulded on the keyboard instead of printed on in white;
13 One silver painted bar below display instead of two bars;
14 Separate “gold” key instead of arc key;
15 Orange instead of blue keys;
16 Any possible variety which still possesses the e^x bug.(the inverse log of 2.02 is bad, not the log of 2.02 as is sometimes thought).

Some varieties don’t exist as an exclusive variety.
Varieties 1 to 4 cover the first 10,000 HP-35s. About 26,000 HP-35s were made in the first 2.5 months after the HP-35 came out; the market estimate was only 1000 units a month.
In 1972, the HP-35 accounted for 6 percent of HP’s revenue, 25 percent of unit shipments and 40 percent of the net profit.
Variety 10 and 15 probably occurred after the introduction of the HP-70.

The HP Calculator Museum in The Netherlands owns a HP-35 with varieties 4,5,6 and 8. Its serial number is 1143A56276 and it is a localised version, which means it does have a Dutch label on the back instead of an English one. A distinct difference between variety 6 and 7 is that the ON-OFF switch has a lower profile for variety 6 than it has for variety 7. Variety 6 also has imprinted text (relief) on the tin keyboard plate as opposed to the printed or screened text for the tin keyboard plate in variety 7.

The first release HP-35’s were possessed by Thomas Osborne and as it seems the father of James A. Donnelly who owns the first HP-35 ever sold according to the HP journal.

The targets (as set by William R. Hewlett himself it seems) for the development of the HP-35 were: cheaper than $500, a weight of less than 9 ounces (255 grams) and it had to fit in a shirt pocket. When also compared to the HP-9100A it had to be 1/10 of its volume and cost and 10 times as fast. The design team it seems almost had to build him a new shirt.

Hardware in the HP-35

The HP-35 utilises 6 chips: microprocessor, control (logic), clock and 3 ROM's which reside in "cans". A total of 212 parts can be found inside. The chips are MOS/LSI circuits.
The microprocessor is in fact an arithmetic and register circuit in one.

This revolutionary calculator was made possible thanks to the introduction of a one-bit microprocessor chip which was made by both AMI and Mostek. I've seen a HP-35 with AMI chips but don't know if any exist with Mostek chips.

This microprocessor, introduced in the autumn of 1971 just before the commercial four-bit Intel 4004, used a 56-bit serial shift register approach, which provides 14 4-bit nibbles. 56-bit registers were in use until the Saturn-based handhelds were introduced.

All internal operations by any HP calculator until now, including the HP-9100A, are done using binary coded digits or BCD. Very simply said, operations are done by shifting the digits and doing logical operations on them. This explains why the advent of the one-bit microprocessor , which used a shift register approach, was so important.

As the timing and control functions are handled by separate ICs, we can't call this a CPU (Central Processing Unit). The microprocessor in the HP-35 is therefore in fact no more than the ALU (Arithmetic and Logical Unit) part of a CPU.

The HP-9100A/B and all HP calculators before the HP-21 and the HP-01 have an ASM (Algorithmic State Machine) design. With ASM it is possible do a maximum of 11 instructions simultaneously, however an average of 7 instructions per branch in each state was normal. This means that these machines were quite fast, there were a lot of buses inside as a result. Later HP calculators incorporate the ASM methodology with microprocessor
technology.

Known developers:

France Rodé	designed the arithmetic and register circuit and two of the special bipolar chips;
Chung C. Tung	designed the control, timing and the three ROM chips and was also one of the developers for the HP-9100A;
Thomas M. Whitney	digital systems and section manager for the HP-35 Pocket Calculator.

Model number: HP-80
Described known varieties: 6

Description of known varieties:

1 ON and OFF key moulded on the keyboard instead of printed on in white;
2 Hewlett Packard 80 label instead of Hewlett Packard label;
3 Serial number printed inside battery compartment instead of printed between the rubber feet on the back;
4 Made in Singapore instead of the USA;
5 One silver painted bar below display instead of two bars;
6 As 5 except that the bar is much thicker and somewhat slanted towards the display.

This calculator sold only about 8 percent of the market estimate.

The HP Calculator Museum in The Netherlands owns a HP-80 with varieties 2,3 and 6. Its serial number is 1247A02783.

Model number: HP-45
Described known varieties: 2

Description of known varieties:

1 On older models: STO - n stores stack register x subtracted with register n in register n;
2 On newer models: STO - n stores register n subtracted with stack register x in register n. The backplate of this variety doesn't mention STO : n in detail.

The HP Calculator Museum in The Netherlands owns a HP-45 with serial number 1603S03216 and it is a localised version which means it does have a Dutch label on the back instead of an English one. It has the text which describes variety 1 but it behaves of course as a variety 2.

Some HP-45s like 1349S48620 have imprinted text (relief) on the tin keyboard plate as opposed to the printed or screened text for the tin keyboard plate in later versions.

Model number: HP-65

The HP-65 was used in the last moon landings to compute course corrections and other spacecraft functions. It used PMOS technology and had numeric LEDs.

Model number: HP-67
Codename: Hawkeye

It used PMOS technology and numeric LEDs; it had the processor of the 25C and ran on about the same speed as the HP-65.

Although called Hawkeye this calculator was first of all called Bearcat. Both the HP-97 (a TopCat) and the HP-67 were introduced on July 1, 1976. During the development of the HP-97 it became obvious that a portable version of the HP-97 was technically possible. The project that eventually gave us the HP-67 was called Bearcat (*bare* cat!).

Known developers:

Robert B. Taggart	project leader for HP's printing calculators;
Lester "Les" Moore	hardware engineer 45, 65, 21, 28C, 28S, 48SX.

Model number: HP-20 series
Described known varieties: 2

Description of known varieties:

1 A display which uses a dot as a separator;
2 A display which uses a comma as a separator; for sale in some European countries.

The HP-25C and HP-27C use more power because of the "Continuous Memory" and can only be used with battery pack HP-82019B.

This series used NMOS technology for the first time.
More units were made of this series than of the Classic series and the price was about one-third of the Classic series. This series was made absolete by the competition.

The HP-21 was the first HP calculator to use a microprocessor (a CPU in fact) that needed to be programmed in microcode. Earlier microprocessors as in the 35, 45, 55, 65, 70 and 80, consisted of just an arithmetic and register circuit. These microprocessors recognise a set of bit patterns and respond appropriately to each one.
The microprocessor of the HP-21 on the other hand has a preliminary stage which reads the bit patterns and converts them to several instructions for the processor itself. Each instruction read by this preliminary stage in effect calls a tiny program. The instructions in this tiny program are called microcode. This type of microprocessor is excellently suited as a platform, which extends the usability of the processor. So one microprocessor can be used for a variety of different calculators such as the 20-series.
The instruction set (which consists of microcode) of the microprocessor used in HP-21 is very similar to the one used for the current Saturn microprocessor.

The microprocessor circuit was for a very small part redesigned (because of the "Continuous Memory") to accommodate the HP-25C. The "Nut" processor as used for the HP-41 series was based on the HP-25C's microprocessor.

Known developers:

John J. Wong	developed integrated circuits for the 25, 25C and 27. Project manager for the 41C's electronics.

Model number: HP-29C and HP-19C
Described known varieties: 1

The HP-29C was, together with the HP-19C, one of the first HP calculators to use a CMOS/SOS memory chip . This was not done on a large scale so some of these calculators may not use this type of memory chip.

CMOS:	Complementary Metal-Oxide Semiconductor
SOS:	Silicon On Sapphire

Model number: HP-30 series
Described known varieties: 5

Sometimes the E-types of this series are referred to as E-series and the C-types referred to as 30XC-series.

Description of known varieties:

1 Early models have a metal plate inside;
2 An asterisk * before the serial number signifies a redesigned keyboard;
3 Keyboard plate of tin with a silver edging;
4 Keyboard plate of tin with a golden edging;
5 Keyboard plate of a polycarbonate plastic with a grey edging.

Variety 4 was very likely only used for the financial HP-37E and HP-38C while variety 5 can be found with all other 3XCs.

Changing the dot to a comma as separator could be done by changing a jumper on the printed circuit board.

The main processor in the 30-series is made by AMI which should be no surprise.

To do a self test: Press STO and ENTER
Error 9 means a bad display; pressing any key gives the fault number for other types of failures.
This series wasn't such a success as the HP-20 series even with a price halve to that of the 20 series; about 2/3 of total units that the HP-20 series sold. The E-series were in fact only there to retain the market share.

Known developers:

William M. Kahan	developed the arithmetic and elementary functions for the 27, 67, 97, 32E, 34C, 85; financial functions for the 92 and 38E, 38C; other functions for the 32E and 34C including ∫ and SOLVE. (which were also used for the 18C and 28C).

Model number: HP-91

The HP-91 was the first HP calculator to use improved algorithms. Older HP calculators use the algorithms which were developed for the HP-35 and really originated from the HP-9100A.

Known developers:

Dennis W. Harms	developed new algorithms, which replaced the algorithms used since the 35, and did the microprogramming for the91. He was also involved in the development for the 67 and 97;
Bernard E. Mush	project manager 55 and 91; was a mechanical engineer for the 35 and 65 and the section manager for the 41.

Inside the HP-91 and other TopCats you would find a main systems processor called ACT (Arithmetic Control and Timing circuit), 3 ROM's and a data storage unit. These elements could also be found in the 20-series. Additionally, the HP-91 and other TopCats would have a 14-digit cathode driver and a keyboard buffer circuit called PICK.

Model number: HP-92
Described known varieties: 1

Description of known varieties:

1 A HP-92 with a redesigned printed circuit board has the serial number in the form of YYWWC9SSSS.

Model number: HP-10
Described known varieties: 1

Description of known varieties:

1 A swing-out, spring loaded security ring on the top right near the AC adapter socket.

Known developers:

William E. Egbert	project leader for the 67, did the microprogramming for the 67 and 97; project leader firmware 19C and 29C; developed firmware for the 41C and is an expert on algorithms;
Edward A. Heinsen	section manager 67, 97 and 01;
Gerald W. Steiger	involved in the development of the 10 and 19C; mechanical and production engineer for the 41C and 71B.

Model number: HP-41
Described known varieties: 4

Description of known varieties:

1 The halfnut variety can be distinguished by the narrow black band underneath the upper of glass protecting the LCD display. A halfnut HP-41CX has an extra printed circuit board (PCB) mounted over the normal PCB;
2 Early HP-41C units had an almost vertical slope to the front of the keys;
3 Early HP-41C units can have two gold-plated ball bearings to the left of the battery compartment, intended for AC operation;
4 Blanknut. This variety doesn't have serial numbers.

Keys used until 1981:

The information that is on the front side of a key, looks like it's a sticker of some kind. This impression is made because the text is on a very small plate that is attached on the key. I assume that this small plate is melted on to the key itself. It is probably done like this for production reasons. Early 41s in 1980 still used this type of keys which have an almost vertical slope to the front which makes reading difficult. Later 41s use keys with labels directly printed to the front side of the key.

Known HP-41C developers:

Norman L. Johnson	worked on several of the CMOS ICs for the 41C including the microprocessor and the display drivers; involved with the development of the CMOSC process at HP;
Ed Liljenwall	industrial designer for the 41C and 71B;
Craig Maze	started in 1978 (so development on the 41C started as early as 1978) as a product engineer on the 41C liquid crystal display program.

Model number: HP-10 series
Described known varieties: 4

There are much more varieties than described below. For example more than 8 different varieties of the HP-12C exist because the backplate changed so much. The HP-12C was produced in the U.S.A., Singapore, Brazil. It is now produced in Malaysia.

Description of known varieties:

1 HP-11C without the asterisk * used as a low power annunciator;
2 Late HP-15C or HP-11C batches which used overpainted HP-12C keyboards;
3 Late HP-16C batches used keyboards overpainted HP-15C keyboards which themselves were overpainted HP-12C keyboards. There is a possibility that some 12Cs exist which use overpainted 12C keyboards themselves;
4 The battery compartment of early models uses metal clips to hold the batteries; two transparent plastic pieces protect the three batteries. Later models use a spring to the left and a gold-plated contact pin to the right; only one transparent piece of plastic to the left protects the batteries.

Besides these varieties several different backplates do exist:

1 1981-1983 Original USA version. The USA to the left of the serial number is more widely spaced than later the later USA version. Some early 12Cs have a lighter printed backside than later models. Around 1982-1983 the text “Complies with....” appears on the backplate;
2 1983-1989 USA version with a smaller spaced USA than in version 1. This version is only found in the 15C and 16C. The16C was produced until 1987, the 15C until 1989. During this timespan the FCC marking “871B” appeared on the backside;
3 1983-1994 Brazil version. The 11C, 12C were produced in Brazil from 1983 . The 15C was, in addition to the USA, produced in Brazil but only in the late eighties. Around 1991 came the CE marking and in around 1993 the NOM marking probably appeared on the 12C. The NOM marking indicated that the calculator complies to Mexico’s importation laws. The 12C was produced in Brazil but with Mexican influence;
4 1994-1995 Singapore version. This version uses different keyboards than the earlier version. The keys have a more mat look and the applied paint looks different, although the 10-series never had moulded keys. The new labelling method is sometimes referred to as screened. It is possible that a Singapore version with NOM1 does exist;
5 1995- Malaysia version with the NOM1 marking.

To do a self test: Press the ON key to turn the calculator off. After a few seconds simultaneously press the ON and the X key. Release the ON key and keep the X key pressed for about a second or so. Now release the ON key. The word “running” will be shown on the display and after a few seconds almost all of the display’s segments will be lit. An error 9 (important number, see HP-30 series) message is displayed in case of an error. Press any key to resume normal operation.

The HP-12C is HP’s most successful calculator of which already millions have been produced.

These series used CMOSC technology instead of CMOS. The CPU is probably an overworked “Nut” as this was a stopgap product after the HP-41C.
HP produced the first CMOSC chip in January 1981. This chip complies to the chip that has to be in either the HP-11C or HP-12C. It has 7808 bytes of ROM and 208 bytes of RAM, a 100-segment liquid-crystal display driver, a clock and an analogue low-battery detector circuit. The chip contains 85,000 transistors on surface of 0.27 cm2. The total operating power dissipation is 0.25 mW. This processor is the only one ever of which a circuit photograph is published in the HP Journal.

This series was the first to be kept longer on the market than earlier series. In 1980 HP made the decision not to continuously upgrade the products because of the state of the calculator market. The competition by then wasn’t as fierce as it used to be.
The vinyl cases of early models are of a better, thicker quality than those with the current model.

Known developers:

Eric A. Evett	software engineer; wrote the microcode for the 11C, 15C and 16C
Bruce R. Hauge	IC packaging engineer for the 10-series (quad packs); designed PCB hybrids for the 18C, 28C;
Paul R. Van Loan	worked on the 41C, 10C, 15C, 16C, 18C, 28C; specialised in IC package development; was project manager at HP's Northwest IC division at the time of the18C and 28C's development;
Nathan Meyers	software engineer; developed algorithms for the 12C and did development on the operating system for the 71B;
Richard W. Riper	manufacturing engineer for the 10-series, 18C, 28C and 48SX;
Joseph P. Tanzini	hardware engineer; wrote the firmware for the integrate algorithm and the complex functions for the 15C and wrote also firmware for many other HP calculators.

HP-80-series including the best known HP-85

The series 80 used an 8-bit HP microprocessor, RAM memory between 128-640 Kbytes and had an IEEE488 interface built in. This series with a price between $ 2000 - $ 4800 were supposed to fill the gap between calculators and computers but it was all to be ill fated.

Model number:	HP-75C and HP-75D
Known prototypes:	A few

The HP-75D was originally to be called the HP-75CX.

Known HP-75 developers:

Megha Shyam	hardware engineer; designed integrated circuits for the 85B, 75C, 71B, 18C, 28C;
Eric L. Vogel	software engineer; wrote application software for the 41 and 75; lead software engineer for the 94; test and development engineer for the17B, 19B, 20S, 27S and project leader for the Equation Library Card.

Model number: HP-71B
Described known varieties: 2

Description of known varieties:

1 Early US units had a metal keyboard plate and a metal plate at the back;
2 Late units from 1986 have an all plastic casing and use a polycarbonate keyboard plate.

Known HP-71B developers:

James P. Dickie	hardware engineer who designed the "Saturn" CPU for the 71B; developed for the 29C and E/C series of Calculators; project manager hardware 48SX.

Model number: HP-18C
Described known varieties: 3

Description of known varieties:

1 Early US units did not have the shifted keys printed above the keys so a special overlay was available;
2 US version of later units;
3 International version. This version has the overlay already printed on the keyboard.

The change between variety 1 and 2 took place in week 25 of 1987 between serial numbers 2725A8559 and 2725A8857.
In 1988 with the advent of the 28S, the backplate changed. Before that the backplate didn't show Hewlett-Packard Co. and a year. It showed in addition to the FCC "871B" marking and the "Complies with...." the following: "ATI conforme classe B". Besides this the serial number was surrounded by a little raised rim.

Known HP-18C developers:

Judith A. Layman	mechanical engineer who developed the keyboard and the flexible interconnect design for the 18C and 28C; also worked on the expansion pod for the 75C and is co-inventor on a patent relating to the articulating hinge for the 18C and 28C;
Susan L. Wechsler	software engineer who worked on the operating system for the 71B and 18C for which (18C) she also worked on the user interface.

Model number: HP-18C

The change of the backplate with the advent of the HP-28S is identical to that of the HP-18C.
However no 28Cs with the newer backplate exist as the 28C was directly succeeded by the 28S.

Model number: HP-19B
Described known varieties: 2

Description of known varieties:

1 US version;
2 International version.

The difference is limited to the text on the top left case part; the hardware is exactly the same.

Model number: HP-19BII
Described known varieties: 2

Description of known varieties:

1 US version;
2 International version.

The difference is limited to the text on the top left case part; the hardware is exactly the same.

In 1996 production moved to Indonesia. Instead of a M in the serial number (for Malaysia) a B (for Brazil) is found.
It is most likely that the calculators are assembled in Malaysia with parts from Indonesia.

Model number: HP-17B
Described known varieties: 2
Recessed / glass plate: Glass plate

Description of known varieties:

1 US version;
2 International version.

The international version has an additional chip on its PCB, see part ”ICs in Pioneer series”).
Possible a version with a glass plate can exist.

Model number: HP-17BII
Described known varieties: 2
Recessed / glass plate: Recessed

Description of known varieties:

1 US version;
2 International version.

The international version has an additional chip on its PCB, see part ”ICs in Pioneer series”.

The visual difference with the17B, besides the glass plate, is a golden rim around the keyboard.

Model number: HP-10B
Recessed / glass plate: Recessed

Model number: HP-14B
Described known varieties: 2
Recessed / glass plate: Glass Plate

Description of known varieties:

1 Normal version;
2 50th anniversary edition (rarer than equivalent HP-32S).

Model number: HP-20S
Recessed / glass plate: Recessed

Model number: HP-21S
Recessed / glass plate: Recessed

Model number: HP-22S
Recessed / glass plate: Recessed

Possible a version with a glass plate can exist.

A change in the height of the LCD segments occurred between serial number 3029S0024 and 3038S04820

Model number: HP-27S
Described known varieties: 2

Description of known varieties:

1 Display with glass plate;
2 Recessed display (rarer).

Model number: HP-32S
Described known varieties: 3

Description of known varieties:

1 Display with glass plate;
2 Recessed display; (rarer)
3 50th anniversary edition (glass plate, less rare than equivalent HP-14B).

Model number: HP-32SII
Recessed / glass plate: Recessed

HP-32SII first would be called HP-32S+

Model number: HP-42S
Described known varieties: 2

Description of known varieties:

1 Display with glass plate;
2 Recessed display (rarer).

General varieties Pioneer series

The Pioneer series have some overall varieties:

1 1988-1989 These USA models have two identical battery clips in the battery compartment and all models have a metal plate on top of the printed circuit board (PCB). All Pioneer calculators use moulded keys in which the labels are part of the key and therefore can't fade. Every calculator from the HP-65 until the Pioneer series used printed or screened keys. A moulded key can only carry one set of characters which sets it apart from screened keys;

2 1989-1993 The right battery clip was made larger during 1989. In 1991 the FCC "871B" marking, which had been present until now, was replaced by the CE marking. In 1990 production was moved to Singapore. Singapore models can be identified by the mat background (instead of a shining one) on which the serial number is pressed. It can also be identified by looking at the metal keyboard plate. The curved edge from the display to the keyboard is much more rounded than the USA version on which a sharp edge can be found. This means that the USA version is more prone to loosing paint at this specific point. From somewhere in 1989 the metal plate disappeared in the 20S and 10B to be replaced by a copper pattern on the PCB which provides the shielding. The 32SII is the only other Pioneer (since its introduction) to use a copper pattern on the PCB for shielding. The 32S and newer 20S calculators (from around 1991) have a finer copper pattern than is present on early 20S calculators;

3 1993-1995 In 1995 the NOM1 (NOM marking has never appeared) marking appeared next to the CE marking. From 94/95 on the moulded keys were replaced by screened keys. In 1997 the17BII was the only Pioneer calculator left with moulded keys;

4 1995- In late 1995 production moved to Indonesia. It is thought that assembly takes place in Indonesia with parts coming from Malaysia as the serial number shows a M.

ICs in Pioneer series:

Both the HP-42S as the HP-17B/BII use the same PCB, rev E 2801 5180-4583.
The RAM IC on this print is the Toshiba TC5564APC, a static RAM chip (CMOS) of 8192 bytes (8-bit words) in a Small Outline Flat Package.

Technical data:

5V	27.5 mW/MHz
Ta=20 °C	0.2 mA
Ta=60 °C	1 mA

(Ta stands for ambient temperature)

In the HP-17B/17BII an additional chip is placed next to the RAM chip. This chip is only found in European versions. It is a ROM chip which purpose is to provide the foreign language support. This ROM IC is the Toshiba TC53257P/F, a Mask ROM chip (CMOS) of 32kB (8-bit words).

Technical data:

5V	120 ns access time
30 mA	operating current
2.0 mA	standby current

Known developers Pioneer series:

Steven L. Harper	software engineer who did programming work for the 01.; did I/O printing and firmware for the 41C and the I/O for the 48SX;
Patrick J. Megowan	software engineer for the 41C, 18C, 19B, 27S, 17B, 20S, 10B, 21S and 48SX.

Model number:	HP 30S
Codename:	?
Product number:	F1900A
Colour:	Grey (?) interchangeable front bezels, 2 extra bezels are included
Release date:	April 3, 2000*
Known prototypes:	?

*According to posts on the comp.sys.hp48 newsgroup the HP website mentioned the HP 30S from Monday April 3, 2000. The HP 30S pages seem to have become available at the same time that the HP 39G/40G pages became available.

This is a scientific calculator with a 7x5 dot matrix display capable of showing 2 lines. The entry system is algebraic. The calculator runs on two LR44 batteries. All Pioneer calculators run on three LR44 type batteries and the HP 6S runs on two LR43 batteries (HP 6S Solar has a single LR43 battery).

Model number:	HP 38G
Codename:	Elsie
Release date:	April 6, 1995
Known prototypes:	2

Description of known prototypes:

1 orange grip instead of green grip; rest of the case is green
2 two rubber feet instead of rubber bar; one rubber feet goes through the s of sin.
A picture of this prototype was published in Educalc catalog #68 in 1995.

The command LIBEVAL 171;0 gives the version number in the following form:

```
version HP-38-A1.67
copyright HP, 1993,95
LIBEVAL 171;0
                              0
```

The command VERSION does the same and gives the following in a window:

```
Version HP38-A
Copyright HP,
1993, 1995
```

The command SYSEVAL 535863 gives the amount of free available memory in the following form:

```
22511
```

Photographs of the inside can be found in the proceedings from the 1995 HP Handheld Users Conference (HHUC). They can be found on page 48 through 53. The printed circuit board (PCB) on page 51 shows F1200 REV A and the ROM chip is labelled as:

ELSIE OTP
REV 1.67

(OTP means One Time Programmable)

The HP-38G was launched as answer to the TI-82. The TI-83 was then launched as answer to the HP-38G.
TI also launched the TI-81 after the HP-38G was launched but this is quite a low-end graphical calculator, which is not meant for direct competition with HP.

Rumour: the product number (38) was chosen to be a combination of 32 and 48. If so, this will be a "doubly referential" product number reference.

The HP-38G was first sold in a box with a cardboard interior; later they were also sold with a plastic interior as happened with earlier Pioneer/Charlemagne models.

Early models used the usual serial number format while later models seem to use the serial number format as used for the palmtops.

First real try in the high volume, low price market that is the territory of TI and Casio.

This calculator was developed by a team of engineers split between Oregon and Singapore because between 1993 until November 1, 1997 the HP calculator "division" resided in Singapore after been in Corvallis, USA for so many years.

Model number:	HP 39G
Codename:	Kimmi*
Product number:	F1906A
Colour:	Dark Blue; translucent blue slide-on hardcover
Release date:	April 3, 2000**
Known prototypes:	?

Model number:	HP 40G
Codename:	Kimmi*
Product number:	F1907A
Colour:	Dark Blue; translucent blue slide-on hardcover
Release date:	April 3, 2000**
Known prototypes:	?

* The Rules command on the HP 39G/40G normally will show the codename of the calculator. As "Kimmi" is the only name that I cannot trace to a person I assume that this is the codename.

**According to posts on the comp.sys.hp48 newsgroup the HP website mentioned the HP 39G/40G from Monday April 3, 2000. The HP 39G/40G pages seem to have become available at the same time that the HP 30S pages became available.

The calculators are supposed to be formally announced at the NCTM '00 (National Council of Teachers of Mathematics) which will be held 12-15 April 2000.

Both graphical calculators are obviously cut-down versions of the HP 49G. Both have only 256 kB of memory and do not have a flash ROM to facilitate a software upgrade. The ROM size is 1 MB.
The HP 39G is meant for the US market and has two-way infrared I/O.
The HP 40G is meant for European market and does not add two-way infrared I/O but does add CAS (Computer Algebra System). The CAS version will be 1.19 as for the HP 49G.

Model number:	HP-48SX
Codename:	Charlemagne
Release date:	March 16, 1990
Known prototypes:	4
Described known varieties:	3

The 48 was called the 1152 at least at some point during design development.

Description of the known prototypes:
At the March 1992 Drexel Conference, some of the mock-ups were on display (courtesy of Dennis York from HP). The mock-ups consisted of a:

1 41-ish case with a (fake) 3-line display;
2 71-ish case;
3 18C-ish case (clamshell);
4 A case that looked a lot like a 48.

In addition was a mock-up of a cassette drive.

Description of known varieties:

1 Early models had a reset hole at the upper left rubber feet;
2 Later models had a reset hole at the upper right rubber feet;
3 Variety 1 or 2 with the letter R (for Reset) moulded at the wrong hole.

The TI-68 (48 + 20 !) was introduced after the HP-48SX. The TI-85 however did try to compete with the 48S, not the 48SX (which has no competition from anybody).

The product number (48) was chosen to be a combination of 41 and 28.
First it would have been called the HP-48CS but was called HP-48SX by the marketing department.

The version can be called up by pushing the ON and the softkey D simultaneously.
Press the backspace key.
Press the EVAL key.
You will now see the following in the display:

```
Version HP48-E
Copyright HP 1989
```

You can return to normal operation by pushing the ON and the softkey C simultaneously.

Or use the command SYSEVAL #30794h

HP-48SX versions before version E (educated guesses):

Version A	33% (An exchange for serial numbers < 3019 took place from 01-01-1991)
Version B	3 %
Version C	4%
Version D	60%

The HP-82240B infrared printer was introduced just before the HP-48SX in 1990. Its predecessor the HP-82240A was introduced in 1986 together with the HP-28C.

(49 keys and aluminium overlay in mercedes medium; case mercedes black)
shift keys different colour for business, scientific and RPN scientific. 48SX uses scientific and RPN scientific shift key colours but only lightened for better readability.

Early models were supplied with a pouch that had a Velcro closure; later models got a pouch with a zipper closure (HP Journal June 1991). My 48SX box shows the pouch with the Velcro closure.

Model number:	HP-48GX
Codename:	Hammer
Release date:	June 1, 1993

Model number:	HP-48G
Codename:	Alcuin
Release date:	June 1, 1993

Model number:	HP-48G+
Codename:	Plus
Release date:	March 30, 1998

From the World Book Encyclopaedia (Dave Arnett):

Charlemagne's grandfather, Charles Martel (688-741) ruled the Merovingian Frans. For repeatedly attacking the Moslems, Charles received the title of Martel, meaning the Hammer.

The Palace School, set up at Charlemagne's capital in Aachen under the leadership of English scholar Alcuin (735-804) stimulated interest in education, philosophy, and literature.

The HP48GX was code named Hammer to signify our commitment to repeatedly attacking in the Scientific Calculator market.

The HP48G was code named Alcuin in that we hoped to reach college-bound students with this product and help them have the skills and interest to excel in their future studies, even before high school graduation.

The HP-48G+ is identical to the HP-48G with the exception that it contains 128 KB of RAM instead of 32 KB. The released HP 48G+ has a release R ROM.

The command VERSION gives the following on the stack (example):

```
"Version HP48-M"
"Copyright HP 1993"
```

The HP-48S used probably for the first time a processor manufactured by the Japanese company NEC. It is possible that late 48SXs use a Saturn that has been manufactured by NEC. Pictures of the HP-38G confirm that its processor is made by NEC.
The processor used in the HP-48SX, the 1LT8, was manufactured at the Northwest IC Division of Hewlett-Packard according to the HP Journal.
The processor in the HP-38G is enclosed in black epoxy while the processor in the HP-48SX is not enclosed in epoxy and "hanging" in a hole (like a spider) of the printed circuit board.
This is also the case of the processors in the Pioneer series that were produced until the advent of the 48S in 1991. After this time the 10B, 20S and 32S use a Saturn processor enclosed in black epoxy and made by NEC. The processors used in the 17BII and in the 42S until it was discontinued were of the "spider" type and from 1991 these processors were produced by NEC and have an NEC marking on them. This could be the reason that the latest 17BIIs still have a metal plate mounted over the PCB. Calculators with a Saturn of the "spider" type perhaps need a more elaborate shielding.

Known developers 48 series (both S(X) and G(X) versions):

Ted. W. Beers	software R&D engineer for the 48S series, 28C, 28S, 48G series, 38G; for the 48G series and the 38G he worked on the user interface elements; co-developed the PDL (Program Development Link) and is now responsible for the next-generation of handheld products;
Preston D. Brown	hardware engineer for the 41CV, 41CX, 71B, 18C, 28C, 28S and 19B; developed the display driver IC for the 41C; production engineer for the 18C and development engineer for the 48SX (Saturn CPU);
Diana K. Byrne	software engineer for the 48SX with regard to plotting, graphics and the EquationWriter; R&D project manager for the 48G series and 38G; she was responsible for managing a team of engineers split between Oregon and Singapore who were working on handheld products for education; she is now employed by Texas Instruments where she was involved for the TI-89;
Paul J. McClellan	software engineer 15C, 71B, 28C, 28S and 48S and G series; wrote the solve and integration routines for the 15C;
James A. Donnelly “Jim”	software R&D engineer for the 71B, 75, 14B, 22S, 32S, 32SII, 42S, 38G and the Equation Library Card; now responsible for the design of the next-generation handheld calculators and information appliances;
Gabe L. Eisenstein	software engineer who worked on the 48GX, 38G, 71B (Forth), 75 (VisiCalc), operating system for the 28C, 28S and 48SX and on the 48SX’s EquationWriter;
Robert W. Jones “Max “	software engineer for the 28C, 48SX, 48G series, 38G; written the “Getting Started Manual” for the 28C and documentation for the 41CX; currently responsible for software development handheld products;
Charles M. Patton “Charlie”	software scientist and mathematical specialist; developed mathematics ROM’s for the 75, 71B, 18C, 28C, 28S, 48S series; worked on RPL for the 48G series and worked also on the 38G;
Mark A. Smith	design and mechanical engineer for the 10C, 15C, 16C, 75D, 18C, 28C, 19B and 28S;
William C. Wickes	software engineer who worked on the operating system for the 28C, 28S, ROM’s 41C (extended I/O ROM), 75C (Math and advanced I/O ROM’s) and 71B (Math and Forth Assembler ROM’s); project manager for the 48SX; also worked on the 48G series;
Bob Worsley	software engineer for the 41C and 48G series; wrote firmware for the 41C (? 71, 75, 28C, 28S, RPL);
Dennis C. York	hardware engineer for the 67/97 (Standard Pac), 41C (firmware) and 48SX (initial vision); oversaw R&D and marketing aspects for the 48G series. Reader might be interested that the codename for the HP 48G was Alcuin who was headmaster of the school in York and was brought over by Charlemagne (codename HP 48SX) to Aachen in 782. The codename for the processor in the 48G, 48GX, 38G, 48G+ and 49G is Yorke.

Model number:	HP 49G
Codename:	V'Ger
Product number:	F1633A (manufactured in Indonesia)
Colour:	Light metallic blue; matching translucent blue slide-on hardcover as opposed to emerald green of the HP 48G series
Release date:	June 21, 1999*
Known prototypes:	Probably several
Retail: Price:	$180
Known prototypes:	?

*Unofficially introduced on the May 1st and May 21st at the Open Days for calculator users in France. The official introduction took place at the American Society for Engineering Education's annual conference.

Although available in Europe in the traditional cardboard box, it seems to be available in a transparent blister pack in the US (as is the HP 6S/HP 6 Solar in Europe).

One of the prototypes had a darker blue slide-on hardcover which was not as transparent as the final slide-on cover.

Technical specifications:

- Memory Capacity: 1.75MB User Memory for data storage (512KB RAM, 1.25MB Flash ROM, the Flash technology provides the possibility for electronic firmware upgrades)
- Four programming languages: HP Basic, User RPL, System RPL, Assembly Language
- Advanced built-in Computer Algebra System (CAS)
- CPU: 4MHz Saturn (Yorke) CPU
- Display: 131x64 pixel Crystal Clear screen (black instead of blue, so higher contrast)
- Keyboard: 51-key keyboard with *rubber* keys that give tactile feedback
- Dimensions: 18.0 x 8.1 x 2.9 cm
- Weight: 264 g (including batteries)

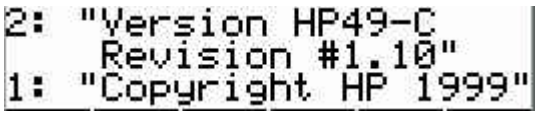
Explanation of the codename V'Ger:

This codename originates from the movie *Star Trek: The Motion Picture*. V'Ger is a contraction for "Voyager." It can be described as a massive machine life-form built around NASA's ancient **Voyager VI** space probe. In the movie the encounter with V'Ger takes place in 2271. **(HP 71; 71-22=49 …)**

Some details on V'Ger which initially appears as a cloud like entity:
- It kills one Enterprise crew member (navigator Ilia), three Klingon warships and one space station
- It has kept a record of Voyager's journey back to earth so you could say it has memory.

The codename V'Ger was first given to me first by Wlodek Mier-Jedrzejowicz but can also be found from within the HP 49G itself (see below for more information). The Voyager family of HP calculators (also known as Series 10) consisted of 5 calculators: 11C, 12C, 15C, 16C, 10C. The Voyager family was a stopgap series which used technology from the HP-41C as HP was developing a new processor design (the Saturn processor which is still used in the HP 49G). The HP 49G can also be regarded as a stopgap product as HP is most likely developing a new platform for future calculators. So for me the HP 49G can be added as part of the Voyager family.

The command VERSION can be used to retrieve the version of the HP 49G; the result is returned to the stack.



As in the HP 48 series and the HP 38G, the command RULES can also be used. The result on the HP 49 screen is the following:

Explanation of names:

ACO*	Australian Calculator Operation
Jean-Yves Avenard	One of the original four developers of the MetaKernel who later on became a HP employee at the ACO
Christian Bourgeois**	
Cyrille de Brebisson	One of the original four developers of the MetaKernel who later on became a HP employee at the ACO
Tanya Brooks	HP 48G Marketing
Mark Carter**	
David Chibo**	
Mitch Davis**	
Jeff Harcourt**	
Mika Heiskanen	Author of ALG48, Jazz etc.
Jian He**	
Garry Heinze	Head Technical Development ACO
Nigel Hooke**	
Gabriel Lagos**	
Peter Lanius**	
Chris Leitao**	
Geoffrey Marnell**	
Kiaran O'Neill**	
Bernard Parisse**	Author of Erable
Dan Smith**	
Rodolfo Sandonata**	
G.T. Springer**	
Ray Suryn**	
Gerald Squelart	One of the original four developers of the MetaKernel who later on became a HP employee at the ACO
V'Ger	Codename HP 49G
Tehn Yit Chin**	
Chris Wallin	Head ACO

** From Datafile V18N6 Page 43

I don't know the full names of the other people mentioned and what their part was in the developing of the HP 49G. Surprisingly Charles Lim is not mentioned here who is (was ?) a Product Manager for the ACO.

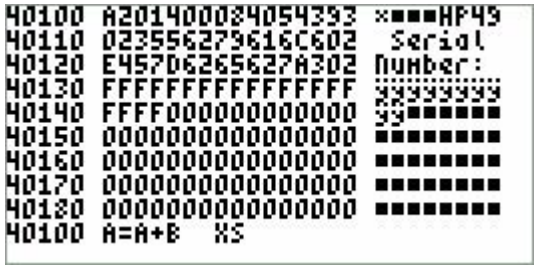
*ACO stands for Australian Calculator Operation; ACO is located in Melbourne, Australia and officially took over the calculator "division" within HP on November 1st, 1997.

Selftests HP 49G

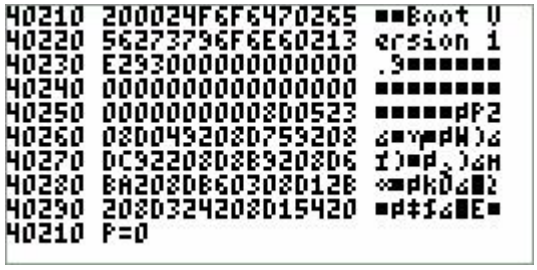
The selftest of HP 49G can be initiated by simultaneously pressing ON and the F4 key (D) and then releasing both keys. The screen then gives you options such as 2 which gives you the CPU speed. Pressing other keys however which are not mentioned gives you much interesting information.

Press **A**

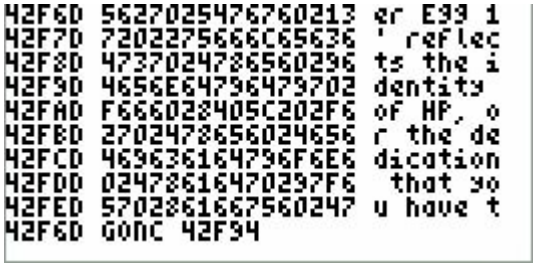
If you scroll down far enough you will see the following:

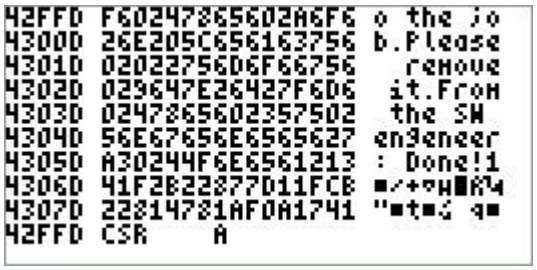


HP49 Serial Number



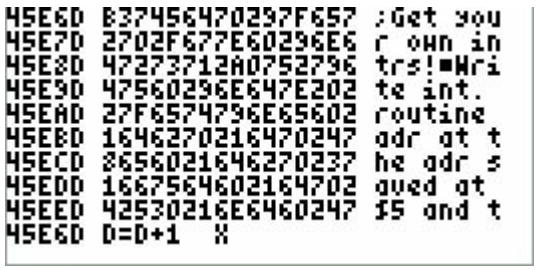
Boot Version 1.9

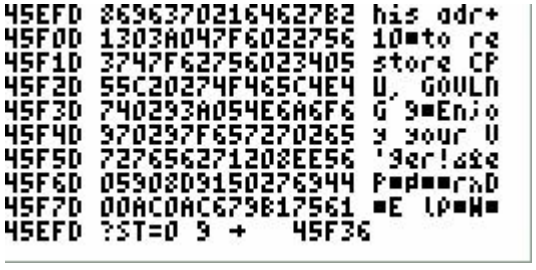




Text from these three pictures (inclusive typing errors):

Ex-Easter Egg 1: From the Software Team Leader: I don't think that 'Easter Egg' reflects the identity of HP, or the dedication that you have to the job. Please remove it. From the software engeneer: Done!





Please note the text **Enjoy your V'Ger**.

There is a known second Easter Egg in the HP 49G. Within any form that accepts input of text, enter exactly this: **"HpMad"** and a "Tetris" like game will start.

Press **B**

Picture of Christian Bouhp ***Christian Bourgeois***

Press **C**
Picture of person; text HPmåd and if you scroll down the text Cyrille appears ***Cyrille de Brebisson***

Press **G**
Picture of person; text Gerald and if you scroll down the text Warlock appears ***Gerald Squelart***

Press **J**
Picture of person; text Jean-Yves (Aka Gherkin ***Jean-Yves Avenard***

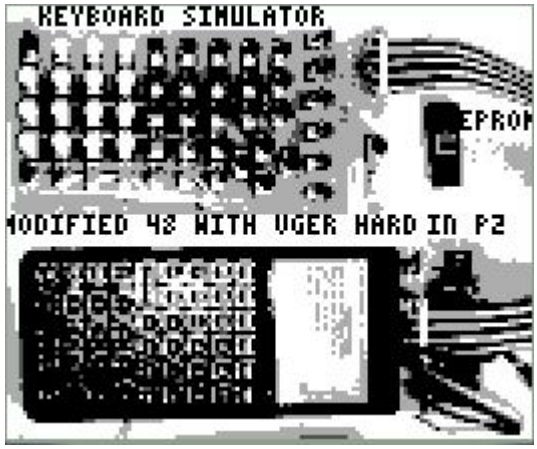
Press **M**
Picture of person; text Mark ***Mark Carter***

Press **R**
Picture of person; text Ray ***Ray Suryn***

Press **S**
Group picture, which includes the text Cyrille, Jean-Yves, Mika, Gerald and Bernard below person's pictures ***Cyrille de Brebisson, Jean-Yves Avenard, Gerald Squelart, Bernard Parisse***

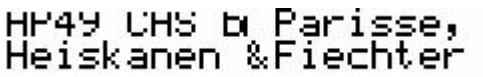
Press **T**
Picture of person; text Tanya ***Tanya Brooks***

Press **V**:



The above picture was combined from two screenshots, which were made using the HP 49G emulator as can(could) be downloaded from for example HP's website.

The following two screenshots are from the starting up of the HP 49G:



The above picture was combined from two screenshots because this screen really flashes by.

256 MENU NXT NXT NXT NXT BetaTesting

Sébastien Eric John
Benoit Balazs Jacob
Christian Philippe
Joseph Jim Scott Eva
Richard Blake Thomas
Wlodek Jonathan
Stéphane M.S. Werner
Gilles Cary Daniel
Christian Dave Colin

A few month after the HP 49G was released it became known that it suffered some minor design problems such as HP 49G units that did have the 0 or 1 key mounted upside down.

Also some HP 49G units seem to have the zenerdiode that protects the serial port for voltages higher than 5V, mounted wrongly which means it will be ineffective.

Finally the blue translucent hardcover was originally made from a soft plastic material which very easily scratched. With the advent of the HP 39G/40G the hardcover for the HP 39G/40G/49G seems to be from acrylic which protects much more against scratching.

At least we have not seen any recalls as happened with the HP-48SX (display) and the OmniGo 100 (power drain).

April 1st jokes

Before the highly anticipated new HP calculator was introduced, two April 1st jokes relating to a new HP calculator came into the world. Below some excerpts from the “press releases”:

1. Hewlett-Packard's Australian Calculator Operation (ACO) announced a new graphic calculator on Thursday, April 1st, the HP 89G, as the successor to the HP48G series. It will sell for approximately US$150 and will include the following features:

2. The Hewlett-Packard Calculator Products Team is proud to announce the all new HP 58SX symbolic expandable calculator!

   The HP 58SX is now the most powerful handheld dedicated calculator ever developed. With the 58SX, you can do anything and everything from basic math to advanced vector calculus. With it's unique new interface and powerful algebraic engine, it can handle any equation you throw at it!

   Product Features –

   The all new RISC Uranus processor, over 100 times faster than the Saturn processor used in the HP 48 series, running at 50Mhz.

Model number:	HP 6S
Codename:	Cosmo
Product number:	F1631A (manufactured in China)
Colour:	Blue
Release date:	March 18 at Cebit 1999 in Hanover Germany, April 1, 1999
Retail: Price:	$14.95
Dimensions:	127 x 72 x 8.5 mm
Weight:	91 grams

Model number:	HP 6S Solar
Codename:	Cosmo
Product number:	F1632A (manufactured in China)
Colour:	Silver
Release date:	March 18 at Cebit 1999 in Hanover Germany, April 1, 1999
Retail: Price:	$17.95
Dimensions:	127 x 72 x 8.5 mm
Weight:	91 grams

These calculators are made for HP in China. They don't have serial numbers but a batch number. For me these calculators look very similar to cheap Sharp calculators, which I have also seen in several OEM disguises. It has recently become known that these calculators are very similar to the Texet Albert. Datafile V18N6 Page 24 shows a picture of the HP 6S Solar next to the Texet Albert. In the same Datafile it is also mentioned that Texet did not have a comparable model to the HP 6S which makes it plausible that this was developed for HP based on the Albert (the HP 6S circuit board does mention HP whereas the HP 6S Solar circuit board does not). These calculators are sold in Europe in a transparent blister pack, which is new for HP calculators in Europe.

Explanation of the codename Cosmo:

According to some, the name "6S" sounds like a wordplay on the word "success". **Cosmo** also could be a reference to solar power.

However my thoughts on this are different. I like to think (because I cannot confirm it) that the codename was **Cosmos** or **Cosmo S**(olar). When there was still a Soviet Union they launched a lot of satellites under the generic name of Cosmos. In fact the Cosmos name was used for satellites, interplanetary probes etc. if they were not working well (failed launches for example). If the satellites, interplanetary probes etc. were working fine they were given a proper name such as Venera, Mars or other series name. As the HP 6S and HP 6S Solar can be regarded as tryouts/experiments in an until know unexplored low-end market, I think the codename Cosmos could be very appropriate.

Model number:	OmniGo 100
Product number:	F1310A
FCC ID:	FCC ID B94F131X (Notice the X)
Codename:	Jedi
Release date:	October 10, 1995 (discontinued April 1, 1997)
CE approval:	August 15, 1995
Retail price:	$ 349

On November 11, 1995 HP recalled all OmniGo 100 organisers with a serial number lower than SG54402000 because of a defect (the battery problem).

Model number:	OmniGo 120
Product number:	F1305A (notice the *higher* number of the OmniGo 100)
FCC ID:	FCC ID B94F1305
Codename:	Leia
Release date:	September 3, 1996 (discontinued April 1, 1997)
CE approval:	May 29, 1996
Retail price:	$ 399

The OG120 was produced along the OG100 if you look at the following serial numbers:
OG120 s/n SG63300216
OG100 s/n SG63400231

It seems that small design changes equally affected the OG100 and OG120.

Backside changes for the OmniGo 120:

- Instead of CE95 now CE96;
- Addition of NYCE Logo;
- Space for an inlay as in HP-200LX and 48G series for an engraved name plate (also for OmniGo 100 ?).

Frontside changes for the OmniGo 120:

- New Pocket Quicken logo (as opposed to the Pocket Quicken logo on the HP-200LX) which is placed above the GEOS logo.
- A Pocket Quicken icon replaces the Calc icon to the right of the display.

The OmniGo 120 features a holographic display, which improves the brightness and readability of the display. The brightness and contrast are up by a factor of 2 or 3.
The display is based on Optimax technology, which was jointly developed by Motorola and Polaroid. The LCD is enhanced by a holographic reflector, which gives a soft green glow.
Optimax is Motorola's trademark for this technology; Polaroid uses Imagix as their trademark. The first use of this technology was by Motorola in their Envoy 150. It is now used in some Motorola mobile phones.
The holographic reflector is made by Polaroid's Industrial Holographic Products Group.

General OmniGo 100/120

Processor:	VG230 from Vadem;based on NEC V30HL
Software:	includes GEOS v2.1 and DOS miniCOMMAND v6
Memory:	576 kB heap space 32 kB video memory 416 kB user storage
ROM:	3 MB (I think the ROM is the same for OG100/120)

Model number:	OmniGo 700LX
Product number:	F1206A
Codename:	Columbia (attached phone is called “Shuttle”)
Release date:	March 14, 1996 (discontinued November 1, 1997)
Known prototypes:	4

Description of the prototypes:

1: Front side look
Hewlett-Packard OmniGo 700 |2 MB RAM|
The Pocket Quicken logo is the same as on the HP-200LX (the so-called old logo)
Three LEDs are on the front with the following text: SMS, FAX and ALM.
The OmniGo text on the top halve of the case is printed on in white.
This prototype is pictured in my book and on HP release brochure (!) 5964-9286DU.
An estimated 2 of these prototypes exist.

2: Frontside look
Hewlett-Packard OmniGo 700 2 MB RAM
Text resides underneath the application keys. This suggests a US version as the US ABA version of the HP-200LX also has text underneath the application keys.
(European ABB versions don’t have this)
The Pocket Quicken logo is the same as on the HP-200LX (the so-called old logo)
Three LED’s are on the front with the following text: SMS, FAX and ALM.
An image of the moon is moulded to the lower left of the keyboard of the OmniGo Stars are moulded to the left of the display. The start-up display shows the moon.
The OmniGo text on the top halve of the case is pressed into the case with Go in the “striped” design. This version has been seen by independent software vendors (ISV) in Europe so not many do exist; perhaps a total number of 20 could be in existence. They were not of a very high build quality and are probable the very first ones to come of a production line.

3. As 2 but without any moulded pictures and in an European layout. This prototype is pictured in product review brochure 5964-2456-EN and in “Codenames of HP Handheld Calculators and PDAs” by M.J.P. Staps.

4. The first OmniGo 700LXs to come on to the market still had the moulded moon. Users thought it was a damaged part of the OmniGo 700LX. An estimated 1000 of these OmniGo 700LXs have come on the market before the design changed. The molded stars and the start-up display have stayed. The OmniGo text on the top halve of the case is pressed into the case with Go in the “striped” design. This version is now on sale and is pictured in the second edition of “A guide to HP Handheld Calculators and Computers” by Wlodek Mier-Jedrzejowicz.
Front side look:
Hewlett-Packard OmniGo 700LX |2 MB RAM|

All the OmniGo 700LXs to appear on the market have the new style Pocket Quicken logo. Three LEDs are on the front with the following symbols instead of text: battery, phone (to show active communications) and a clock (acts as an alarm light). This probably means that the LED to the most left was changed from one to show that a SMS message had been received to one that shows the battery condition.

Model number:	HP 200LX (the 4 MB version)
Product number:	F1216A
Codename:	Lynx
FCC ID:	FCC ID B94F1060 (same as other HP-200LX Palmtop PCs)
Release date:	February 3, 1996 (discontinued November 1, 1999)
CE approval:	November 16, 1996
Retail price:	$ 599

For this "new" HP 200LX a new manual came out probable because at the same time the 1 MB HP 200LX and HP 1000CX was discontinued (April 1, 1997 for the HP 200LX, February 1. 1997 for the HP 1000CX). The 2 MB and 4 MB versions of the HP 200LX and a 2 MB version for the HP 1000CX will be discontinued on November 1st, 1999.
The new manual is Edition 1 October 1996. The declaration of conformity in this manual is identical to the first HP 200LX manual, Edition 1 June 1994. A separate piece of paper is therefore included containing a new declaration of conformity. A major change is that the LED is now part of the testing. This is shown on the cardbox packaging inside and with a sticker on the backside of the palmtop (to the left of the power supply imprinting).
The box of the HP 200LX is also changed; HP 200LX is now in yellow instead of red, the backside of the box is also changed.

Model number:	HP 300LX
Product number:	F1220A
Codename:	Luke (Model I)
Release date:	April 1997* (discontinued April 1, 1998)
Prototypes:	1
Retail price:	$ 499
Specifics:	44 MHz SH-3, 2MB RAM, 5 MB ROM, no backlight

Model number:	HP 320LX
Product number:	F1221A
Codename:	Luke (Model II)
Release date:	April 1997*
Prototypes:	2
Retail price:	$ 699; price dropped to $ 599 on August 12, 1997
Specifics:	44 MHz SH-3, 4MB RAM, 5 MB ROM, green backlight

Both weigh 442 grams including the batteries.

*There were two press releases on these two handhelds before these handhelds were "officially" released. The dates were February 2 and March 18, 1997. There was never a press release with an "official" release date.

These palmtop PC's use the Windows CE operating system (codename Pegasus). During development these palmtop PC's were also referred to as OmniGo 300LX and OmniGo 320LX. However these names were dropped; the most likely cause is that it has to do with the failure of the OmniGo 100 and OmniGo 120.
CE officially means nothing however most people say it stands for Consumer Electronics.
The least accepted explanation is Communication Enabled but other nice ones are
Compact Edition and Consumer Edition.
Personally I think it stands for Caveat Emptor (Latin for "let the buyer beware").
HPC stands for **H**andheld **PC** but sometimes people say **H**and**p**alm **C**omputer.
Anyway HP got a lot of extra publicity because of the HP in HPC.

Companies who initially came out with an HPC:
Compaq Companion

Casio Cassiopeia (it is called after a star constellation which resembles the letter W)
HP-300LX and HP-320LX
All of the above HPC's use the Hitachi SH-3 RISC chip
Philips Velo 1 with a MIPS R3000 (the only HPC then with a built-in modem)
NEC MobilePro with a NEC VR4101

HP released some preliminary information on their new Palmtop PC after November 11, 1996 (the start date of the Las Vegas Comdex 1996 show). At first, HP didn't want to do release any preliminary information on their new Palmtop PC until they saw what the competition did at the Comdex. The official HP press release on the new Palmtop PC came on November 17, 1996.

The picture they published on the website (also published in the magazine Datafile) is said to be a mock-up. Some features that were released on the website included:

- A display of 640 by 240 pixels as opposed to the competition which only offers 480 by 240 pixels;
- HP 100/200LX, OmniGo 100/120 PIM Translation software;
- Upgradable ROM;
- 2 MB or more RAM;
- Backlight option on some models;
- Compact flash slot on some models;
- Available in US mid-1997.

The picture on HP's website showed the non-backlit model, which we know as to be the HP-300LX. The ON key to the top-right is preceded by the backspace key.

In early 1997, HPs website was changed with regard to the new palmtop PC.
The following new information could be read:

- Standard with 2 MB RAM; Enhanced with 4 MB RAM, backlit and a CompactFlash Card slot;
- A serial cable (!) and communication software (!) is included;
- Docking cradle is included with the enhanced model;
- 5 MB upgradable ROM;
- Hitachi SH-3 32-bit RISC CPU running at 44 MHz;
- Microsoft Windows CE Version 1.1 as opposed to the competition which uses version 1.0.

Strangely enough some information mentions a SH-3P running at 40 MHz.
The computer magazine Personal Computer World had a bigger picture, which featured a backlit model (page 62 of their February 1997 issue). This is very clearly a mockup (first known prototype) because of the "rough" edges. The display also doesn't seem to be as real as it is of an exceptional quality. The backlit model differs from the non-backlit model that the ON key is first preceded by a green on white backlit key (all keys are white) which itself is preceded by the backspace key. This backspace key is smaller than on the non-backlit model. The keys are black on white except for the "special" keys like ON, backspace etc. which are white on grey. The Fn key is white on green. The keyboard clearly shows that part of it can be used as a numerical keypad.
The picture also shows just the Hewlett-Packard logo as usual; no reference can be found to the product name. This picture can also be found in a HP document that is titled "HP Palmtop PCs Positioning" dated October 10, 1996.

A Dutch computer magazine which is published weekly (Automatisering Gids) published a story about the new Palmtop PCs from HP on January 24, 1997.
Some very interesting details were disclosed in this article. The following information was disclosed by Shaun Hobbs, European product manager for HP's Palmtop PCs and Arjan Postma, product manager from HP in Holland.

- HP has the exclusive right to Windows CE version 1.1 for about one year. This version makes a 640 by 240 pixels resolution possible;
- The new palmtops will be called 300LX and 320LX;
- Direct printing via infrared or the serial port is possible only in WinCE 1.1;

- The 300LX and 320LX are seen as extensions of the LX -line of products;
- Market share LX-line in US: 43%; in Europe 14%; the market share has to go up;
- The UK and Holland (using US-English versions) are seen as testing markets for Europe;
- The introduction has date been put forward for the US-English version towards April 1997 and around September localised versions should appear;
- Operating time should be between 40 and 60 hours;
- Price should be 700 and 950 guilders in Holland.

A note to the above:

The price doesn't seem to be right as they seem to be directly extracted from the US prices ($ 499 and $ 699). As the article puts emphasis on the relation between the 200LX and the new 300LX and 320LX it looked very likely by then that these new palmtops will be called the HP-300LX and HP-320LX.
Others said it would be called the OmniGo 300LX and OmniGo 320LX.
However if you look very closely at the picture that was on HP's website, it is very unlikely that the new products are called OmniGo as there is not enough space.

Possible frontside look:

Hewlett-Packard 300LX Palmtop PC

A very early prototype was shown on the Luke Data Sheet dated September 5, 1996.
It did not have Hewlett-Packard on the top left side so a possible frontside look could be:

OmniGo 320LX |4 MB RAM|

Looks an as seen in HP advertisements:

Hewlett-Packard *PALMTOP PC* (the look that the HP 360 LX *has*)
The text 320LX was written just above the backlight key.
This look was later used for the HP 360LX, the HP 320LX you could buy never had this look.

???? Palmtop PC
The question marks are here because the picture in this advertisement showed only part of the HP-320LX.
It could therefore either be Hewlett-Packard or Hewlett-Packard 320LX at the top left side of the display.
The text 320LX was written just above the backlight key.
The HP 320LX you could buy never had this look.

The HP 320LX can also be found as an OEM product for Ericsson where it is called the MC 12.

Model number:	HP 360LX
Product number:	HP F1238A
Codename:	Spitfire II
Release date:	October 13, 1997
Specifics:	60 MHz SH-3, 8 MB RAM, 10 MB ROM, natural white backlight

457 grams

The difference between the HP-320LX and the HP-360LX is that it is a CE 2.0 HPC as opposed to to CE 1.1. It comes with 2 NiMH batteries, which can be charged with the included AC adapter. The HP-320LX came with 2 alkaline batteries and could only use rechargeable NiCd batteries.

The HP 360 LX has the Hewlett-Packard *PALMTOP PC* look as described with the HP 300/320LX. The text 360LX is printed above the backspace key at the top right.

The HP 360LX can also be found as an OEM product for Ericsson where it is called the MC 16.

Model number:	HP 620LX
Product number:	HP F1250A
Codename:	Skywalker I
Release date:	November 17, 1997
Specifics:	256 colour LCD, 75 MHz SH-3, 16 MB RAM, 10 MB ROM, autodimming backlight
Weight:	586 grams with batteries

The backside of the HP 620LX does not have a serial number imprinted anymore. All the product information, serial number, approvals etc. are now printed on a sticker.

On July 1st, 1998 the European price of the HP 620LX dropped to $949 (exc. VAT) compared to a price of over $1000 before. In a press release, HP claimed 43% of the worldwide market share since the introduction of Windows CE.

(small detail: a pre-production HP 620LX did not have the CompactFlash slot)

Model number:	HP 660LX
Product number:	
Codename:	Skywalker II
Release date:	June 4, 1998
Specifics:	256 colour LCD, 75 MHz SH-3, 32 MB RAM, 10 MB ROM, autodimming backlight, 56k6 PCMCIA modem included
Weight:	586 grams with batteries

This model was only being sold in North America.

Model number:	HP Jornada 420
Product number:	F1255A
Codename:	Skyhawk
Release date:	February 1, 1999
Specifics:	250 grams, 240 by 320 screen, 256 colour, 8MB RAM, 8MB ROM, 100 MHz Hitachi SH-7709a 32-bit processor

This PDA has a bluish-purple colour with matching transparent cover.
"Jornada" is a Spanish word that can be translated into "a day's work".

*Sometimes referred to as the HP Jornada 420 Palm-size PC

Model number:	HP Jornada 428
Product number:	
Codename:	Nighthawk
Release date:	Announced earlier than the HP Jornada 420
Specifics:	Chinese model of the HP Jornada 420

Model number:	HP Jornada 430se
Product number:	HP F1796A
Codename:	
Release date:	September 27, 1999
Specifics:	250 grams, 240 by 320 screen, 65,536 colours (software selectable 8-bit or 16-bit colour display) 16 MB RAM, 8MB ROM, 133 MHz Hitachi SH-7709a 32-bit processor

Besides having more memory and a faster processor, this model can play MP3 files. This PDA played a small role in the 1999 James Bond move "The World Is Not Enough" and was bundled (US only) with some James Bond promotional items that were related to the movie. For Europe the demand was totally underestimated meaning that the model was difficult if not impossible to obtain.

The Jornada 4xx are "Wyvern" class Windows CE devices.

Model number:	HP Jornada 540
Codename:	?
Release date:	April 18,2000*

Model number:	HP Jornada 545
Codename:	?
Release date:	April 18,2000*

*April 18, 2000 is the expected introduction date for the new Windows CE (3.0) software release which is now called Pocket PC.

The HP Jornada 540 and 545 are both "palm sized" PDAs as the HP Jornada 4xx. These two PDAs do run the Pocket PC software.

Model number:	HP Jornada 680
Product number:	F1262A
Codename:	Apache
Release date:	March 17, 1999
Specifics:	256 colour, 6.5-in screen CSTN, 640 by 240 pixels desktop-style keyboard (76% of a normal PC keyboard), 510 grams with standard batteries, 133 MHz Hitachi SH-3 32-bit processor, 16 MB SDRAM, 16 MB Burst Mode ROM (user upgradeable) , 56Kbps v.90 modem built-in Microsoft Windows CE 2.11, or Microsoft Windows Handheld PC Professional.

Sometimes referred to as the HP Jornada 680 Handheld PC

Model number:	HP Jornada 690
Codename:	?
Release date:	?

This palmtop size PDA is similar to the HP Jornada 680 but has 32 MB of memory instead of 16 MB. Currently it is still only available in North America.

Model number:	HP Jornada 820
Product number:	F1260A (HP 820), F1261A (HP 820E)
Codename:	Thunderbird
Release date:	Oct 8, 1998
Specifics:	8.2-in VGA CSTN screen, 190 MHz Intel StrongArm RISC processor (SA- 1100), 16 MB RAM, 16 MB ROM, OmniSolve calculator (?), 56k6 internal modem included (HP Jornada 820e only)
Weight:	1100 grams with standard batteries

Sometimes referred to as the HP 820 on HP's website.

This is a Jupiter class Windows CE device, running Microsoft Windows CE 2.11, or Microsoft Windows Handheld PC Professional.

Codenames:

Jedi:	OmniGo 100
Leia:	OmniGo 120
Luke I, Luke II:	HP 300LX and HP 320LX (Palmtop PCs with Windows CE 1.1)
Spitfire II:	HP 360LX (Palmtop PC with Windows CE 2.0)
Skywalker I:	HP 620LX (Colour Palmtop PC with Windows CE 2.0)
Skywalker II	HP 660LX (as the HP 620LX but with 32 MB of RAM and a bundled 56k6 PCMCIA modem)
Chewbacca:	Future Advanced Calculator (codename idea by Marc Staps and Wlodek Mier-Jedrzejowicz)

There was also a model called HP 340LX Palmtop PC (4 MB of RAM) with product number F1237A This product was most likely codenamed Spitfire I as a Spitfire II codename exists. The codename Spitfire II was known to me in September 1997. This was well before the HP 360 LX was introduced so the decision not to market the HP 340LX was taken in a very early stage. The HP 340LX was most likely similar to a HP 320LX with the faster 60 MHz SH-3 processor as used in the HP 360LX.

Princess Leia Organa stored the secret plans of a Death Star in the memory banks of the android R2-D2 before being captured. Together with these plans she also stored a holographic message featuring herself appealing to General Obi-Wan Kenobi for help.

Luke Skywalker saw this message which became the starting point for him to become a Jedi Knight which is a defender of the Force. He rescued Leia and destroyed the Death Star.

Chewbacca is a two-meter tall Wookie who serves as a co-pilot on the Millennium Falcon. Over 200 years old, Chewbacca has spent his last two decades at the side of pilot Han Solo.Chewbacca has a price on his head because he is a runaway slave, smuggler and he is involved with the rebellion. He did also protect Leia when Han Solo couldn't.

Interpretation and speculation with regard to the above:

Luke and Leia are in fact brother and sister.
Both have the Force strong within them but only Luke is a full Jedi Knight.
The "holographic message" is related to the holographic display of the OmniGo 120. The "secret plans of the Death Star" are an analogy for the Windows CE operating system. So Luke has been given early notice of things to come earlier by the competition than he will. HP will introduce Windows CE palmtops in April 1997 while the competition have introduced Windows CE palmtops as early as November 1996.

The codename "Jedi" for the OmniGo 100 was most likely to be designated as the family name for the OmniGo products. In a foreword to the OmniGo 100 manual the following is said: ".... and have worked hard to deliver the vision with the HP OmniGo 100." and "This is only the beginning.".

As for "Chewbacca", a new highly Advanced Calculator, he is a close friend to both Leia and Luke. They are all part of a big family.

Easter eggs in HP handhelds

HP-95LX, HP-100LX, HP-200LX, HP-1000CX, HP OmniGo 700LX

The following thing can be seen when running the display test in the self-test. You get into the self-test by pushing the ON and the escape key simultaneously. Keep the escape key down and release the ON key.

```
There only was this thing from HP
That fit in your pocket; you see.
      A cave man would stare
      And pull out his hair
And wonder,  “What could this thing be?”
```

HP-300LX, HP-320LX, HP 360LX, HP620LX*, HP 660LX*

The following thing can be seen when running the complete diagnostic test in the self-test. You get into the self-test by simultaneously pushing the S key and the reset button which is located inside the backup battery compartment.

The main screen says Luke Diagnostics 0.01 and the full diagnostic test is the last option.
You’ll see the following after pressing the spacebar several times (you’ll see the standard set of display tests):

```
                  HHHHHHHHHHHHHHHHHHHHHHHHHHHHH
          Do not lay up for yourself treasures on earth, where
                    Moth eat and rust destroy,
                and where thieves break-in and steal

           But lay up for yourself treasures in heaven, where
                   Neither moth nor rust destroys,
               and where thieves do not break-in or steal

          For where you treasure is, there will be your heart
                  HHHHHHHHHHHHHHHHHHHHHHHHHHHHH
```

This text is taken word by word from the Bible; it is from St. Matthew Chapter 6 verse 19-21.
As this palmtop is codenamed Luke it looks like somebody either made a mistake or did this on purpose.

*the diagnostic routine was not adapted to cope with the higher speed of these palmtops. This means that the above text flashes away so fast that it can’t be read. It is also not possible to do a step by step self-test as can be done on a HP 300/320LX. I don’t know what the situation is on a HP 360LX but I assume that it is similar to the HP 300/320LX.

HP OmniGo 100, HP OmniGo 120

The following thing can be seen when running the display test in the self test. You get into the self test by pushing the ON, the next and a shift key simultaneously. Keep the next key down and release the ON and the shift key.

```
The time has come
      The walrus said
            To talk of many things

Of Shoes and Ships and
Sealing Wax
      Of Cabbage and Kings
            And why the sea is boiling
            hot And Why Pigs have wings
```

HP-48G, HP-48G+, HP-48GX

Use the command RULES to get the following:

```
            M G
     P   DIANA
   CHARLIE X B     D
BILL U   N  TED    A
O  A L   N    ALCUIN
B  I    JIM   V
 RON     S    E
```

To me this looks like a cow with a big hump on its back like Brahma, the advanced calculator that wasn't to be.

Explanation of names:

William C. Wickes "Bill"	software engineer
Bob Worsley	software engineer
Ron Brooks	marketing
Clain Anderson	marketing
Charles M. Patton "Charlie"	software engineer
James A. Donnely "Jim"	software engineer
Dennis C. York	oversaw R&D and marketing aspects
Diana K. Byrne	R&D project manager hardware and software
Robert W. Jones "Max"	software engineer
Ted W. Beers	software engineer
Gabe Eisenstein	software engineer
David Arnett "Dave"	hardware engineer
Paul J. McClennan	software engineer
Alcuin	codename HP-48G
Dan Coffin	manual writer

HP-38G

Use the command RULES to get the following:

```
C  F      D
HELEN    JIM
A  N  T   A
R  GABE M N
L     DIANA
I       X
ELSIE
```

To me this looks like the roadrunner (cartoon figure) or an ostrich.

Explanation of names:

Elsie	codename HP-38G
Charles M. Patton “Charlie”	software engineer
Helen Choy	software engineer
Feng Yuan	software engineer
Gabe Eisenstein	software engineer
Ted W. Beers	software engineer
Diana Roy	“learning products”
Robert W. Jones “Max”	software engineer
James A. Donnelly “Jim”	software engineer
Diana K. Byrne	R&D project manager hardware and software

HP-39G/40G

Use the command RULES to get the following:

```
    C  F      D
    HELEN    KIMMI
JIM A  N  T   A
  A R  GABE M N
GERALD    DIANA
  K I       X
   JEAN-YVES
```

Explanation of names:

As the HP 39G/40G are sucessors to the HP 38G, only three names are different from the HP 38G “graphic”:

Jean-Yves Avenard	One of the original four developers of the MetaKernel who later on became a HP employee at the ACO
Mark Carter	
Kimmi	Unknown so this could be the codename

RPL meanings

Possible explanations for the acronym RPL:

What HP published:	ROM-based Procedural Language (Charles M. Patton)
What the hobbyists made of it:	Reverse Polish Lisp (HP, Wlodek Mier-Jedrzejowicz)
And to finish it off:	Reverse Polish Language

RPL was developed from 1984 to June 1986 and is a hybrid of FORTH and LISP. LISP is still in use with artificial intelligence projects.

Technical data

ROM versions:

A change in a letter signifies a new version, bugs have been removed, no difference in functionality while a number change means a big difference; no bugs have been removed in this case.

Examples:

The version number of the HP-28C or 28S can be obtained by the following command:
`SYSEVAL #000Ah`

Versions 1AA and 2AA were prototypes; please notice that there are two ROM chips.
The HP-28C had versions 1BB and 1CC while the HP-28S only had 2BB.

The version number of the HP-71B can be obtained by the following command:

VER$

The most reliable version seems to be the 2CDCC. (yes, there are 4 ROM chips in this one)

Details of electronics

Read the sections on the HP-35 and HP-21 for details on the electronics in these early HP calculators.

HP-01

Used technology:	CMOS/LSI (**L**arge **S**cale **I**ntegration)
Specific details:	This watch tolerates a magnetic field of up to 60 Gauss The watchband was one of the few things made outside HP. The display is another example; it was developed and produced by a company called OED

The HP-01 uses a 48-bit processor similar of design to the one in the HP-35; the main difference is that the processor of the HP-01 has a sleep mode.
The circuitry consists of 5 CMOS IC chips and 1 bipolar chip, which total 38000 transistors.

Overview of the circuitry

- Control and Timing circuit
- ROM
- ROM
- Arithmetic and Register Circuit which operates on a digit serial and bit-serial basis
- Clock and Display Circuit
- Display driver (bipolar)

HP-41

Used technology:	CMOS/SOS; first “full” CMOS product; CMOS had to operate > 4 V
Specific details:	Everything was one single four-layer PCB except the module containing two display drivers Around 1.5 million 41’s of all types were produced

The HP-41 has a CPU called “Nut” and one module containing two chips as display drivers. The last component is a bipolar chip, which isn’t CMOS. There are 11 CMOS IC’s in the HP-41C.

Overview of the circuitry

CPU

The system timing and the instruction set are similar to the HP-21 while using the CPU that was initially developed for the HP-25C. The “Nut” CPU is twice as fast as the HP-25C.

ROM

Old 41C and 41CV’s had three 40 Kbit ROM’s while newer ones have a single 120 Kbit ROM.
On the 41C this meant one module with one 40 Kbit ROM and one with two 40 Kbit ROM’s.
The 41CX has two 120 Kbit ROM’s.

RAM

Early 41C’s have five RAM’s containing 16 registers each. The RAM module consisted of a hybrid module contains 4 RAM chips with a total of 56 registers.
Later 41’s use one 16-register RAM and N 64-register RAM’s dependent on the type of 41.

Power consumption

	Typical	Worst
Run	10 mA	15 mA
Standby	1 mA	1 mA
Sleep	10 µA	30 µA

The charging of the batteries in a 41C while it is on will take about 17 hours. If it is off it will take around 6 hours. The operating time with fully charged batteries is between 3 and 6 hours.

How the results are displayed on a HP-41

The HP-41, and all HP calculators -which don’t use a derivative of the Saturn chip- display results with:

mantissa sign 10-digit mantissa exponent sign 2-digit exponent

Each sign and each digit occupies one nybble. (a nybble is half a byte, hence the "y"; it can also be called a nibble, and is 4 bits long)

That makes 14 nibbles, or 7 bytes, or 56 bits for a single number. Although internal calculations are to a higher precision, final results are 56 bits long, so the engineers used registers that long. Internally, a lot of work is done a nibble at a time, since this allowed data transfer over a 4-bit wide bus, which was reasonable at the level of technology when HP introduced their handheld calculators. The machine language instructions we know are not true machine code, they appear to be a microcode, which translates into even lower code on the core of the CPU, and it is said that this true core CPU only has a 1-bit bus!

(This means that each RAM register on the HP-41 totals 7 bytes)

HP-71B

The HP-71B has 4 hybrid ROM's and 4 hybrid RAM's. The instruction set of the CPU is based on that of the HP-41. The CPU does BCD (hence the nibbles) and hex arithmetic.

Power consumption

	Worst
Off	0.03 mA
On	7.5 mA
Beeper	10 mA

HP-28S

Specific details: The HP-28S uses an industry standard RAM chip instead of a 71B-type chip

Power consumption

	Worst
On, printing graphs	35 mA
On, printing text	14 mA
On, no printing	8 mA
Idle	1.0 mA
Off	25 µA

How the results are displayed on Saturn based HP calculators

All HP calculators which use a derivative of the Saturn chip, display results with:

Mantissa sign 12-digit mantissa exponent sign 3-digit exponent

Internally, all calculations are done with 15 digits.
The numbers are stored as 64 bit words and consist of three parts, the signs, mantissa and exponent. Both the mantissa and exponent sign are catched in one nibble. This is very possible as a nibble equals 4 bits which equals 2^4=16 combinations. Only 4 sign combinations are needed.

So a number is equal to 64 bits, 16 nibbles ore 8 bytes.

HP-48SX

Power consumption:

	Worst	1 RAM card	Open I/O	Infrared	Other
	Maximal	Typical	Typical	Typical	Typical
On	80 mA	10 mA	10 mA	9 mA	8 mA
Idle	20 mA	1 mA	6 mA	4.5 mA	3.5 mA
Off	50 µA	10 µA	-	-	11 µA

HP-95LX

Overview of the circuitry (all CMOS)

- CPU - NEC V20H 5.37 MHz
- two 512 kB ROM's
- one 512 kB RAM
- one logic chip (called "Hopper")

HP-95LX1MB

Overview of the circuitry (all CMOS)

- CPU - NEC V20H 5.37 MHz
- two 512 kB RAM's
- one 1 MB ROM
- one logic chip (called "Hopper")

HP-100LX, HP-200LX, HP-1000CX, OmniGo 700LX

Overview of the circuitry (all CMOS)

- CPU - Intel 80C186 7.91 MHz
- two 2 MB, 1 MB or 512 kB RAM's
- one 2 MB (100LX) or 3 MB ROM
- one logic chip (called "Hopper")

Power consumption of the HP-100LX while charging:
100 mA for the first 6 hours, after that it is 45 mA.

Release dates and development times

Development times since the HP-95LX

HP model	RAM	ROM	Release date	Development time
95LX	512 kB	1 MB	23-04-1991	0
95LX1MB	1 MB	1 MB	02-03-1992	314
100LX	1 MB	2 MB	04-05-1993	742
100LX2MB	2 MB	2 MB	01-02-1994	1015
200LX	1 MB	3 MB	01-08-1994	1196
200LX	2 MB	3 MB	01-08-1994	1196
1000CX	1 MB	3 MB	27-03-1995	1434
OmniGo 100	1 MB	3 MB	16-10-1995	1637
OmniGo 700LX	2 MB	3 MB	14-03-1996	1787
OmniGo 120	1 MB	3 MB	03-09-1996	1960
200LX	4 MB	3 MB	03-02-1997	2113
1000CX	2 MB	3 MB	03-02-1997	2113
300LX	2 MB	5 MB	April 1997	2170-2199
320LX	4 MB	5 MB	April 1997	2170-2199

Development time between handhelds:

HP model	RAM	ROM	Ratio	Development time
28S	32 kB	128 kB	4	0
95LX	512 kB	1 MB	2	1205
200LX	2 MB	3 MB	1.5	1196
200LX	4 MB	3 MB	0.75	917
320LX	4 MB	5 MB	1.25	974-1003
95LX1MB - OmniGo 100				1323
100LX2MB - 200LX (4 MB)				1098
100LX - OmniGo 700LX				1045

Probable introduction dates according to the above theory:

HP model	1000 days▪	1100 days	1170 days
48GX	26-02-1996	05-06-1996*	14-08-1999
200LX	27-04-1997**	05-08-1997	14-10-1997
38G	31-12-1997	10-04-1998***	19-06-1998
OmniGo 100	12-07-1998****	20-10-1998*****	29-12-1998

▪ Days after the HP model was released
* 1100 days after 05-06-1996 gives us 10-06-1999; HP 49G introduced at June 21, 1999
** HP 300/320LX introduced at March 18, 1997
*** HP 48G+ introduced at March 30, 1998
**** HP 660LX introduced at June 4, 1998
***** HP Jornada 820/820e introduced at October 8, 1998

High-end calculators (over $ 400)

Year	73-75	75-78	78-84	83-88
71	0	0	0	0
72	0	0	0	0
73	0	0	0	0
74	150	0	0	0
75	100	0	0	0
76	40	150	0	0
77	0	320	0	0
78	0	270	0	0
79	0	260	130	0
80	0	180	420	0
81	0	85	750	0
82	0	30	570	0
83	0	15	650	60
84	0	10	420	50
Totals 71-84	290	1,320	2,940	110

So in the period 71-84 a total of 4,660,000 high-end calculators were produced.

Calculators below $ 400

Year	35	21	E	3XC	1XC
71	0	0	0	0	0
72	50	0	0	0	0
73	265	0	0	0	0
74	320	0	0	0	0
75	160	400	0	0	0
76	0	485	0	0	0
77	0	270	0	0	0
78	0	135	210	0	0
79	0	30	340	15	0
80	0	0	260	150	0
81	0	0	130	215	60
82	0	0	35	80	310
83	0	0	15	15	430
84	0	0	0	0	580
Totals 71-84	795	1,320	990	475	1,380

The total number of units produced for these series is 4,960,000.
If we add this number to the 4,660,000 high-end calculator we get a total of 9,660,000 calculators produced until the end of 1984.

Guesses for 1984 –1999

1XC	41	Clamshells	Pioneer	48	Palmtops	Other*
3,500	1,000	1,000	1,500	1,000	900	100

* My estimate is that 20,000 units for the 75 and 94 series and 30,000 71B's were produced in this timespan. Also included are 50,000 38G units.

The total number of calculators and handheld computers produced since 1984 becomes 9,000,000 units. If we exclude the handheld computers we get about 8,100,000 units.
Add these 8.1 million units to the 9,660,000 units produced until the end of 1984 and we'll get 17,760,000 calculators.

Guess for the number of HP calculators since 1972:
18 million

Guess for the number of HP Palmtops (not including the Windows CE Palmtops):
0.9 million

In 1997, HP sold almost 253,000 (252,540) Windows CE Palmtops, a market share of 43 % in the Windows CE market (information from Dataquest). In 1996 HP sold about 186,000 Palmtops (educated guess with the help of information from Dataquest). 1998 information from Dataquest indicates that HP sold 270,000 palmtops which relates to a 12.1% market share for the PDA market. Although this 1998 figure does not give any information on HP's market share for the Windows CE market but HP's increase from 253,000 to 270,000 was low compared to companies like 3COM (Palm).

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