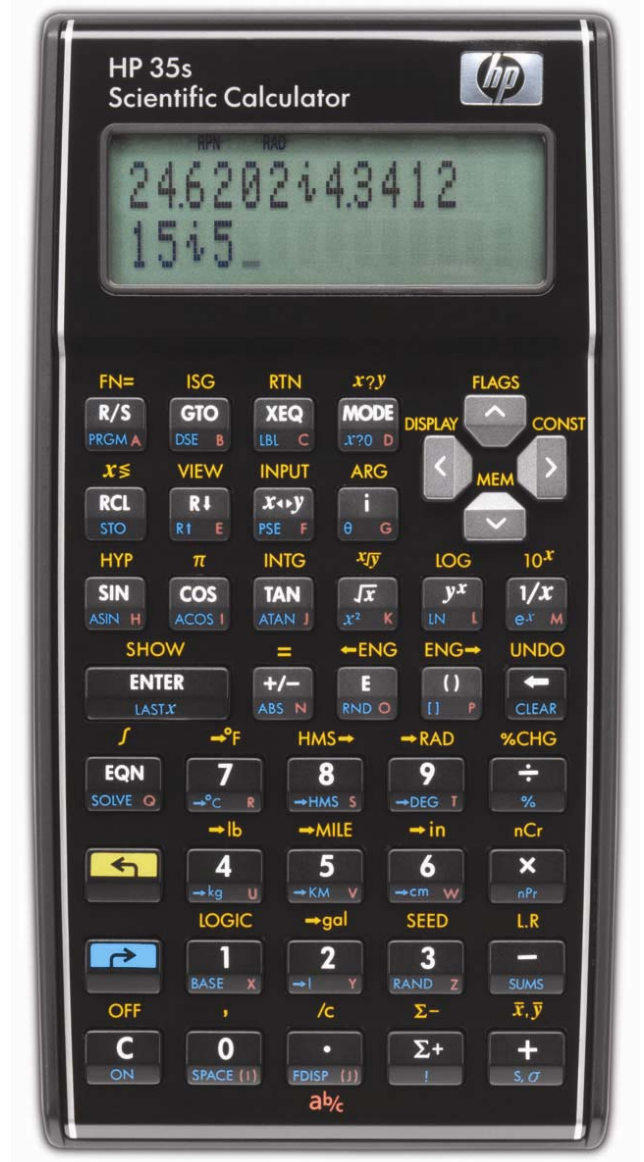**hp calculators**

HP 35s Programming using line numbers

Programming the HP 35s

Using line numbers rather than labels

Example

Programming the HP 35s

Doing a simple calculation once on the HP 35s is easy. Doing the same calculation many times, or doing a complicated calculation, takes longer. It can be better to store all the steps needed for the calculation in a **program**. A program is a set of instructions, stored all together. Once it is written, it can be tested to see if it works correctly. Then it can be used many times, without the need to press every key of the calculation each time.

A simple program is just a set of keystrokes stored so that they can be carried out with one key. The HP 35s provides many commands to let programs do more, for example stop and ask for input, or show an intermediate result. This training aid concentrates on simple programming; it also shows a few of the more advanced programming commands.

Using line numbers rather than labels

The HP 35s has 26 labels for use to define programs or transfers to locations within programs. Unlike the HP 33s, the HP 35s also includes the ability to transfer execution to specific line numbers within one of the 26 labels. This allows for a much greater utilization of program memory without using labels excessively.

For example, the program line below illustrates how a goto instruction can now branch to a line number within a lettered label. Step B010 tests whether the value in the X register is less than the value in the Y register. If true, step B011 transfers execution to step 018 of label B. On the HP 33s, step B011 would have required a goto instruction pointing to a step with one of the 26 labels.
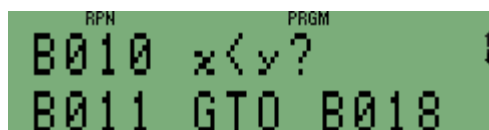

Figure 1

In the past, using line number GTO and XEQ instructions in programs was difficult if changes were made to the program after these instructions were entered, since the program steps would have changed but the transfer instructions would still have pointed at the old line numbers, making the program work incorrectly.

The HP 35s removes this constraint. When a program containing line number GTO or XEQ instructions has a step added or deleted, the HP 35s **dynamically** changes the lines referred to by these instructions to point at the correct location. For example, if in the program shown in figure 1 above, another step were added before step B010 such as an ABS instruction, steps B010 would become step B011 and step B011 would become step B012. More importantly, the HP 35s would change the new step B012's GTO instruction to continue pointing at the same location within the program – step B019 in this instance. This is shown in figure 2 below.
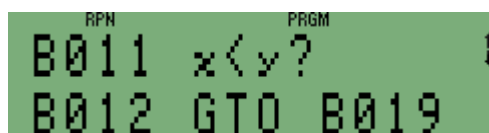

Figure 2

This dynamic renumbering allows for the use of line numbers in GTO or XEQ instructions without the drawbacks earlier, less-advanced calculators may have had.

In detail, the HP 35s handles changes in a program containing line number GTO and/or XEQ instructions as follows:

Edit performed	HP 35s program dynamically changed so that
A step is inserted before a GTO or XEQ instruction	All GTO and XEQ instructions are renumbered to point to the revised (higher step number) location
A step is deleted before a GTO or XEQ instruction	All GTO and XEQ instructions are renumbered to point to the revised (lower step number) location
The step pointed to by a GTO or XEQ instruction is deleted	Any GTO or XEQ instructions continue to point to the same instruction. The instruction that now fills the previous step number is the destination of the transfer instruction.

The HP 35s now offers the ability to take advantage of a large program memory capacity, limited only by a user's imagination.

Example 1:   Rewrite the program from page 14-4 of the HP 35s User's Guide to use only one label. Use line numbers for all transfer instructions.

Solution: The program as presented on page 14-4 looks like this:

S001	LBL S	S008	RCL B	S015	RTN
S002	INPUT A	S009	RCL A	Q001	LBL Q
S003	INPUT B	S010	X^2	Q002	X <> Y
S004	INPUT C	S011	XEQ Q001	Q003	X^2
S005	INPUT D	S012	XEQ Q001	Q004	+
S006	RCL D	S013	XEQ Q001	Q005	RTN
S007	RCL C	S014	SQRT		

Steps S011 through S013 would need to be changed to point at the step after S015 RTN. Since we will be removing the LBL Q instruction, steps previously labeled Q002 through Q005 will now be right after step S015 RTN. They would now be labeled S016 through S019. The XEQ instructions found at steps S011 through S013 should now point to step S016. The revised program using only one label is shown below.

S001	LBL S	S008	RCL B	S015	RTN
S002	INPUT A	S009	RCL A	S016	X <> Y
S003	INPUT B	S010	X^2	S017	X^2
S004	INPUT C	S011	XEQ S016	S018	+
S005	INPUT D	S012	XEQ S016	S019	RTN
S006	RCL D	S013	XEQ S016		
S007	RCL C	S014	SQRT		

The program is not only one total line shorter but uses only one label. Consistent use of line number GTO and XEQ instructions allows for better utilization of the 26 letter labels.