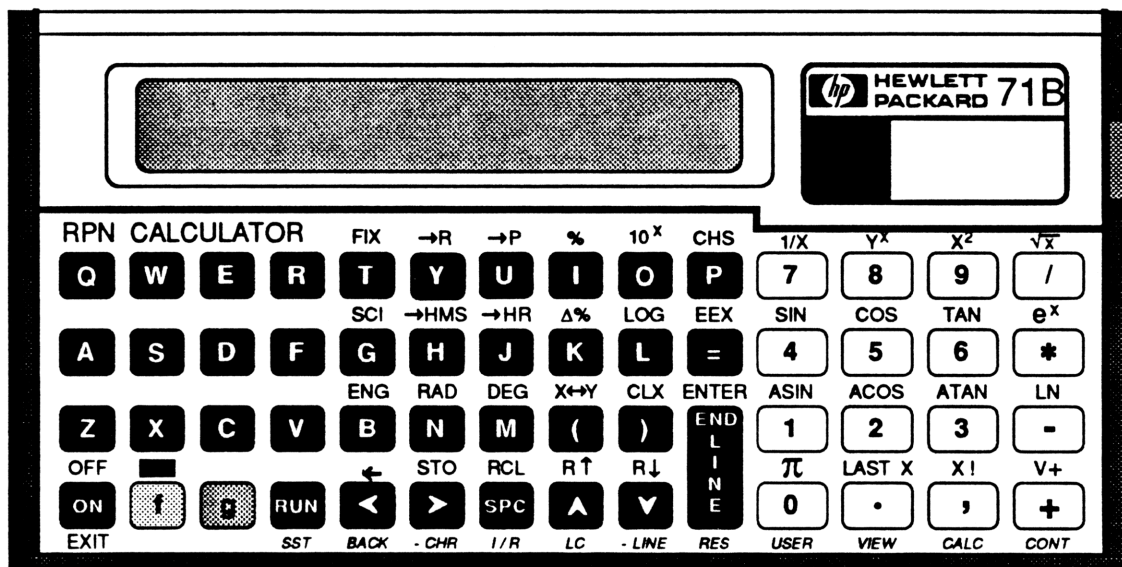


V7539-71-6

HP71 RPN Calculator



An RPN calculator program for the HP71

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INTRODUCTION

Description

The **HP71 RPN Calculator** program provides you with a full function RPN calculator. Unlike **CALC** mode, which uses algebraic notation similar to that used by **BASIC**, the **RPN Calculator** functions the same way as a standard HP calculator such as the HP11C or HP41C.

RPN Calculator is written entirely in HP71 machine code. It is a compact and fast program which has complete control of the keyboard and display.

Features

- **Size** - The program is small enough so that it can be left in memory, ready to use, while occupying only a small fraction of the available memory.
- **Functionality** - The program acts like a real RPN calculator. Keyboard entry and display format are similar to a standard RPN calculator. The program supports 27 mathematics, 10 data manipulation, 3 display format, and 2 mode control functions.
- **Speed** - Functions execute quickly with no discernible delay.

Overlay

A color-coded overlay is provided to label the keys. Where possible, current key definitions are kept the same. Also, the labels for certain, commonly used keys are replicated so that **BASIC** can be used without having to remove the overlay.

USING THE RPN CALCULATOR

Getting Started

There are two cards supplied with the package. One is labeled **RPN CALCULATOR** and contains the main program. The other card is labeled **RPNLEX** and contains a LEX file which allows you to interface the calculator program to BASIC. Its use is detailed at the end of manual. For now, all you need is the **RPN CALCULATOR** card.

Read in the program using the **COPY CARD** command. Once the program is in main memory it can be **RUN** like any other program. (Since it is written in machine code and is type **BIN** it can not be edited or listed.) To start the calculator type **RUN RPN [ENDLINE]**. You may wish to use **DEF KEY** to set up a **USER** mode key to start the program with a single key-stroke.

Indicators

Once execution begins you will see the **PRGM** indicator come on, showing that the program is running. Although the **PRGM** indicator usually means that the HP71 is in a high current drain mode, in this case it is not. The HP71 is kept in standby (light sleep) mode unless it is executing a key entry. You will notice that the **AC** indicator also comes on. This is to remind you that the **RPN Calculator** program is active, as opposed to some **BASIC** program. Think of **AC** as meaning **Auxilliary Calculator**.

Overlay

Place the overlay over the keyboard and snap it into place. The overlay shows how each key is defined by the **RPN Calculator**. Also, along the bottom edge of the overlay, the standard definitions of certain editing and control keys are replicated. Although the "typing aids" are hidden, this allows you to use the HP71 in its standard **BASIC** mode with the overlay in place.

USING THE RPN CALCULATOR

Numeric Entry

Numbers are entered in the same way as standard RPN calculator via the numeric pad and the **EEX** and **CHS** keys. **EEX** allows you to enter the exponent part of a number and **CHS** changes the sign of the part currently being entered. The **-** key allows you to edit a number by successively deleting the rightmost character.

Functions

The function keys are divided into two groups: shifted 'gold' functions above the white numeric pad area and unshifted 'black' functions labeled above the black alpha keys. The 'gold' functions are accessed by first pressing the gold **[f]** key and then pressing the white key under the function label. The 'black' functions are invoked by simply pressing the black key under the desired label.

Accuracy and Range

The **RPN Calculator** uses the full accuracy and range of the HP71 mathematical functions. Numbers are stored internally with 15 digits of accuracy. Up to 9 displayed digits may be selected in either **FIX**, **SCI**, or **ENG** modes. (A display of 10 thru 12 digits and/or **STD** mode may be pre-selected from **BASIC**.) The range of usable numbers extends from $\pm 0.00000000001E-499$ to $\pm 9.99999999999E499$.

'Inf' and 'NaN'

The HP71 and therefore the **RPN Calculator** support the concepts of **Infinity** and **Not a Number**. For example, $1/0$ is defined as infinity and displays as **Inf**, while $0/0$ is undefined and displays as **NaN**. Both **Inf** and **NaN** remain on the stack and may be involved in further calculations. If **Inf** is in the display and you press **1/X** the result is zero

USING THE RPN CALCULATOR

and is so displayed. However, any calculations involving **NaN** remain undefined and result again with **NaN** in the display. **NaN** can be removed from the display by pressing the **CLX** key.

Warnings and Errors

Depending on the the Math Exception Trap Values (see pages 57-60 of the **HP71 Owner's Manual**) certain conditions, such as underflow, may generate a warning or error message. A warning will cause the calculator to beep and briefly display the warning message. Since warnings are 'non-fatal' you may continue with your calculations.

If the Trap Values are set such that an error does occur, it is fatal and halts the execution of the program. If this should happen, execute either **DEFAULT ON** or **DEFAULT EXTEND** and then press **RUN** to return to the calculator program.

Exiting from the calculator

To exit from the program press either **EXIT** or **[f] OFF**. **EXIT** returns you to the main operating system where you can enter or run other programs. **OFF** turns the HP71 off, but leaves you in the calculator program. When you next turn the HP71 back on you will still be in the **RPN Calculator** mode. In either case the values on the stack and in the storage register will be preserved and available the next time the program is run.

FUNCTION SUMMARY

Arithmetic

+	$y + x \rightarrow x$	
-	$y - x \rightarrow x$	
*	$y \times x \rightarrow x$	
/	$y \div x \rightarrow x$	
1/X	$1 \div x \rightarrow x$	
%	$x \text{ percent of } y \rightarrow x ; y \rightarrow y$	
$\Delta\%$	$(x-y) \div y \times 100 \rightarrow x ; y \rightarrow y$	% change
X !	$x \text{ factorial} \rightarrow x$	
V+	$z + x \rightarrow x ; t + y \rightarrow y$	vector addition

Transcendental

X²	$x^2 \rightarrow x$	
\sqrt{x}	$\sqrt{x} \rightarrow x$	
X^Y	$x^y \rightarrow x$	
LOG	$\log_{10} x \rightarrow x$	base 10 logarithm
10^X	$10^x \rightarrow x$	
LN	$\log_e x \rightarrow x$	natural logarithm
e^X	$e^x \rightarrow x$	

Trigonometric

SIN	sine $x \rightarrow x$
COS	cosine $x \rightarrow x$
TAN	tangent $x \rightarrow x$
ASIN	arcsine $x \rightarrow x$
ACOS	arccosine $x \rightarrow x$

FUNCTION SUMMARY

Trigonometric (cont)

ATAN	arctangent $x \rightarrow x$
π	$\pi \rightarrow x$
→P	$\sqrt{x^2 + y^2} \rightarrow x$; $\tan^{-1}(y \div x) \rightarrow y$ rectangular \rightarrow polar
→R	$x \cos y \rightarrow x$; $x \sin y \rightarrow y$ polar \rightarrow rectangular

Time Conversion

→HMS	H.dddd \rightarrow H.mmss	decimal \rightarrow hour,min,sec
→HR	H.mmss \rightarrow H.dddd	hour,min,sec \rightarrow decimal

Data Manipulation

STO	$x \rightarrow$ register	store
RCL	register $\rightarrow x$	recall
R↑	$x \rightarrow y$; $y \rightarrow z$; $z \rightarrow t$; $t \rightarrow x$	roll stack up
R↓	$t \rightarrow z$; $z \rightarrow y$; $y \rightarrow x$; $x \rightarrow t$	roll stack down
X↔Y	$x \rightarrow y$; $y \rightarrow x$	x exchange y
ENTER	$x \rightarrow y$; $y \rightarrow z$; $z \rightarrow t$	
CLX	$0 \rightarrow x$	
LST X	last $x \rightarrow x$	
CHS	$-x \rightarrow x$ (or change sign during numeric entry)	
EEX	Enter exponent	

Mode Control

DEG	Set trigonometric mode to degrees
RAD	Set trigonometric mode to radians

FUNCTION SUMMARY

Display Format

FIX n Fixed (0→9)
SCI n Scientific (0→9)
ENG n Engineering (0→9)

Note: Only a 0 thru 9 digit display can be selected by the format functions within **RPN Calculator**. To obtain a 10 thru 12 digit display or to use the **STD** display mode:

- 1) **EXIT** the calculator program.
- 2) Execute the appropriate **BASIC** command (**FIX**, **SCI**, **ENG**, or **STD**).
- 3) Re-enter the calculator program by pressing **RUN**.

THE RPNLEX FILE

What is RPNLEX?

RPNLEX is a LEX (Language Extension) file that adds to **BASIC** four functions that allow you to transfer data between the **RPN CALCULATOR** and the standard **BASIC** environment of the HP71. Anytime that **RPNLEX** is resident in the HP71 the functions will be available. It is important to note that the **RPN CALCULATOR** does not require the **RPNLEX** file to operate. **RPNLEX** is only needed if you wish to transfer data between **BASIC** and the **RPN CALCULATOR**.

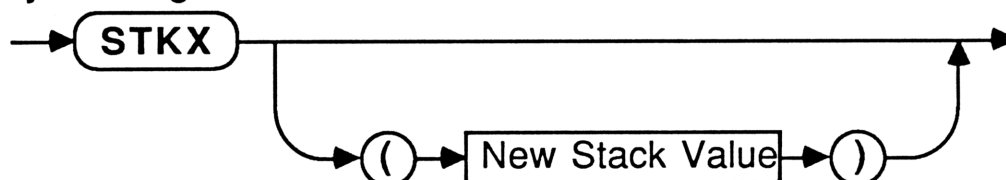
Using RPNLEX

To implement the new functions simply read in the card labeled **RPNLEX**. Once the file is in memory the following four functions will be available:

STKX[(x)]	Access X in the RPN CALCULATOR stack
STKY[(x)]	Access Y in the RPN CALCULATOR stack
STKZ[(x)]	Access Z in the RPN CALCULATOR stack
STKT[(x)]	Access T in the RPN CALCULATOR stack

Each of these functions return the current value of the respective stack entry in the calculator. By supplying the optional parameter (x), the function will also replace the stack entry with the value of x, where x is any valid numeric expression.

Syntax Diagram



Examples

LET A = STKX The value of the **X** stack entry is placed in the variable **A**.

LET A = STKX(B) The current value of the **X** stack entry is placed in the variable **A** and the value of the **X** stack entry is replaced by the value of the variable **B**.

THE RPNLEX FILE

File Not Found

If one of the **STK_** functions is used when the **RPN CLACULATOR** program is not in memory, a **File Not Found** error message will result. If this occurs, copy the **RPN CALCULATOR** program back into the HP71 memory. This same error will occur if the program has been **RENAMED** to anything besides **RPN**.

CALLing RPN from BASIC

The **RPN CALCULATOR** can be invoked from **BASIC** by using the **CALL** statement. This feature may be used to add pre or post processing in **BASIC** to calculations performed in the **RPN CALCULATOR**. By using the **PUT** statement, you can even put keystrokes in the keyboard bufer that will be executed from inside the calculator program.

The following example demonstrates these techniques. The program first prompts for a rectangular coordinate pair. It then places their values in the calculator stack. Next, it puts the RPN keystrokes for '**→P**' and '**EXIT**' into the keyboard buffer. **RPN** is then **CALLed** which executes the keystrokes and calculates the polar coordinates and **EXITs**. These coordinates are then transferred back out of the calculator stack, placed in variables **R** and **A**, and then displayed.

```
10 INPUT"Rectangular (X,Y):";X,Y
20 D=STKX(X) @ D=STKY(Y)
30 PUT"U" @ PUT"#43" ! '->P','EXIT' keys
40 CALL RPN
50 R=STKX @ A=STKY
60 DISP"Polar: ";R;"",",",A
70 END
```

Although the calculation in this example could have been easily done entirely in **BASIC**, it does demonstrate how you can access any of the functions provided by the **RPN CALCULATOR** program.

Statement of Program Philosophy

I remember the great debates. It was the mid-70's and they occurred on college campuses across the nation. HP vs TI. RPN vs 'Algebraic Operating System™'. Which was the better system for calculators?

With my wonderful HP45 in hand, I championed the HP way. I (and the rest of the HP converts) fought TI's "You enter the problem just as it is written down!" with "But RPN is the way you think. It lets you enter the problem the way it develops in your head!".

Years went by. Newer HP calculators arrived. The 25C, the 33E, and then the HP41C ! I started to hope that my trusty HP45 would fail so that I could justify buying the 41C. Alas, HP quality continued to prove itself. Finally, I gave up hope, reluctantly retired my old friend, and bought the 41C. The joys of RPN continued.

Then, one day, I walked into a trade show, and there in the HP booth, shone the HP71B! An HP calculator (in size at least) that ran BASIC! And it has a keypad with the familiar four functions down the side. It has a CALC mode. But wait! It doesn't use RPN. It uses Algebraic! Oh no! Has HP abandoned the true faith?

True, I tell myself, BASIC is algebraic, and to mix RPN with it on the same machine might be confusing to some. But what about those of us who have lived and breathed RPN for the last x years? Does HP truly expect us to give up the fight now and learn to subsist on a diet of parenthesis and '=' keys? Something must be done!

Hence was born the idea for the HP71 RPN Calculator program. Written in HP71 machine code, it is a small, fast, and useful RPN emulator.

The program is small enough to fit on a single magnetic card. This makes it both easy to read in and more importantly, small enough to be left in memory, always available for instant use via a simple RUN command.

It is fast. Press a key , and the result appears almost instantly. It responds like a real RPN calculator.

To keep it small, the emulator is not programmable, there are no statistical functions, and it has only one data storage register. After all, for complex or data intensive calculations the HP71 does run BASIC.

What the program does have is a rich set of the functions most likely to be used in the short, day-to-day calculations for which it is intended. It also includes functions unavailable in HP71 CALC mode, such as time conversions, percent change, and vector operations.

For those of us who find RPN the natural way to solve computational problems, the RPN Calculator program is a valuable addition to the best pocketable computing machine HP has yet to come up with, the HP71!