

A Casio FX-702p Emulator

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A bit of history and nostalgia

The Casio Fx-702p was my first handheld programmable computer except for a very short-lived TI-57 so I learned to program with it and it followed me from the beginning of high school to the end of my college years.

I still own this calculator, now more than 30 years old and still perfectly functional.

A few years back, I found my old Fx702p programs at my parent's house. One of them was computing planets positions, written at a time where only information to be found on the subject was in books available in specialized bookshops in big cities... It was a major effort for the beginner programmer high-school student I was then.

So nostalgia kicked in and I wanted to run it again. Being unable to load the tapes directly into the Fx-702p, I read them on a PC with the utilities found on Marcus Von Cube website:

<http://www.mvcsys.de/doc/casioutil.html>

And still being a programmer after all those years, I decided to write an emulator. Of course, it proved longer than expected and the first run of the planets position was giving wrong results so I wrote a debugger...

Original Manual & other documentation

I found the original English documentation here:

<http://pocketcomputerworld.free.fr/Manuals/FX-702P.pdf>

For more information about the nice little machine, one of the first Basic programmable handheld calculators after the Sharp PC-1211, you can look here:

http://en.wikipedia.org/wiki/Casio_FX-702P

Main Functions

Files, Programs & Variables

The Casio Fx-702p supported up to 10 different programs simultaneously, P0 to P9 and up to 226 variables as well as a special string only one.

It supported saving just one program at a time or all the programs and variables.

The emulator can load and save files containing either one program or all of them and optionally, variables and debugging information.

Screen

The main screen is pretty straightforward: it is an exact copy of an Fx-702p. Clicking on keys presses them.



Menus

The File Menu

Open File	Load a .702 file
Reload	Reload the last .702 file if it contained only one program
Reload All	Reload the last .702 file if it contained only multiples programs
Save	Save the current program

Save As	Save the current program in another file
Save All	Save all the programs and variables
Save All As	Save all the programs and variables in another file
Quit	Quit the emulator

The Program Menu

Run	Run the current program
Debug	Debug the current program, opening the debugging window if needed

Popup Menu

Main screen popup offers a fast access to the File & Program menu functions.



Keyboard shortcuts

Menus shortcuts are displayed in them and most of the Fx-702p keys are mapped to their obvious PC/Mac keyboard equivalent including arrows, F1 and F2. A few keys have special shortcuts:

MODE	Ctrl+O
↑	^
C	Backspace or Ctrl+H
AC	Ctrl+C
STAT	Ctrl+T

STOP	Ctrl+S
ANS	Ctrl+A
CONT	Ctrl+Q
EXE	Return

These keys display a tooltip reminder of their shortcut when the mouse is over them.

Debugger

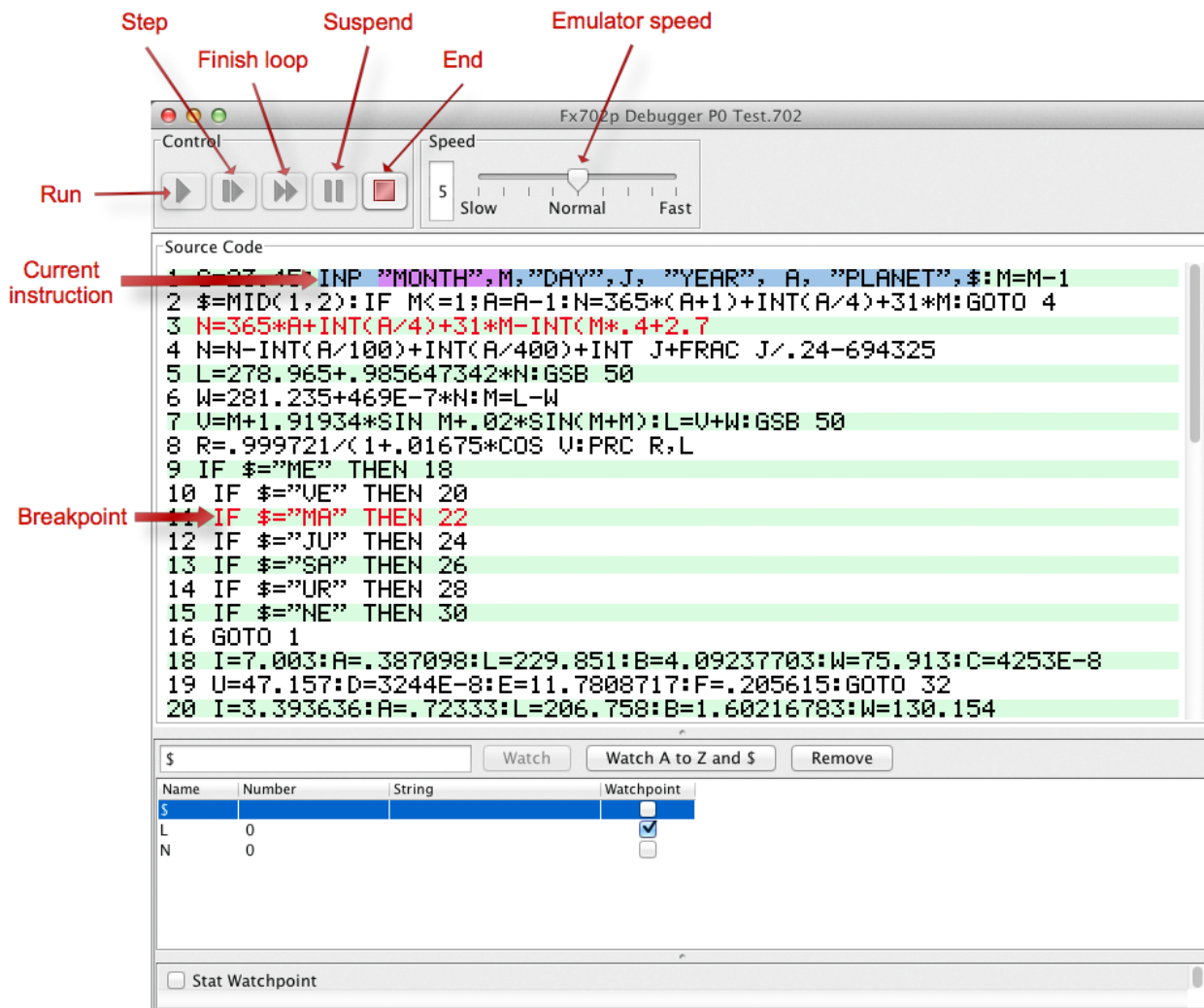
Goal







Debugging on the original Fx-702p was not obvious: one had to use the Trace mode and interim PRT instructions for instance.

So the emulator features a symbolic debugger with a comprehensive set of functions:

- Displays the source code
- Display the current instruction
- Supports multiple breakpoints
- Shows variables values
- Can stop when a specific variable is modified
- Shows stat registers values: CNT, MX, MY, SX, SY, SX2, SY2, SXY
- Can stop when a stat operation is done

Main Functions

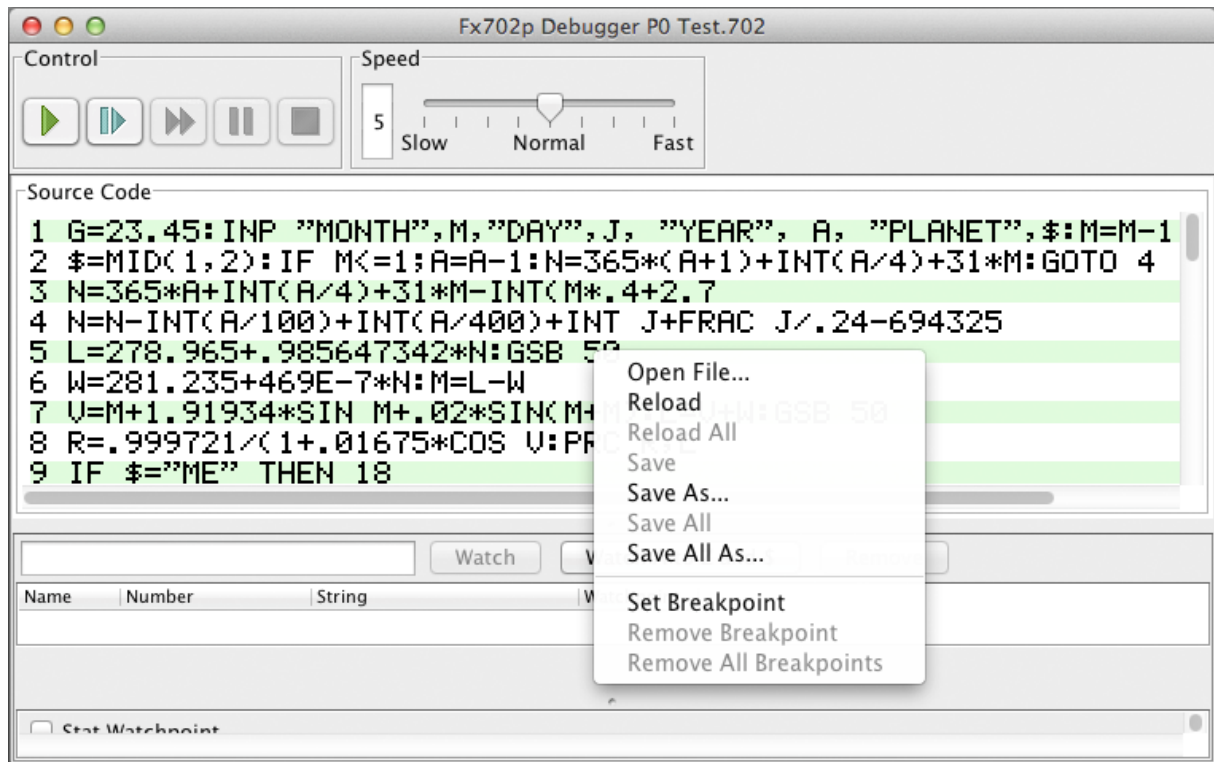


	Run the current program till its end, a breakpoint or watchpoint.
	When the program is suspended, resume execution. Position is the same as the Run button.
	Step, i.e. execute the highlighted instruction and suspend.
	Finish loop: when in Step mode on a NEXT instruction, execute the entire loop and suspend.
	Suspend execution
	End program
Emulator speed	Set the emulator speed. Normal tries to be as close as possible to a real Fx702p. Fast is full speed.
Current Instruction	The Source Code panel highlights the current instruction in blue . If this is a composed instruction, i.e. PRT or INP, the current sub-instruction is highlighted in purple .
Breakpoint	Double clicking on an instruction in the Source Code panel toggles it as a breakpoint. It is then displayed in red .

Popup Menu

Debugger popup offers a fast access to the File menu functions and to breakpoints management:

Set Breakpoint	Activate a breakpoint. Equivalent to double clicking on an instruction that is not a breakpoint.
Remove Breakpoint	Remove a breakpoint. Equivalent to double clicking on an instruction, which is already a breakpoint.
Remove All Breakpoints	Remove all the breakpoints in this program.



Keyboard shortcuts

The debugger implements a few shortcuts for its main functions, the same as the popular Eclipse development tool.

Other keys are redirected to the main window so you can answer to INP instruction without leaving the debugger.

Icon	Function	Shortcut
	Run	F11
	Continue	F11
	Step	F6
	Finish Loop	F7
	Suspend	F3
	End Program	Ctrl-F2 or ⌘-F2 on OS X

Variables and Watchpoints

Variables can be watched, i.e. their value displayed and modified in real-time when you enter calculations or run a program.

Once a variable is watched, it can become a watchpoint: program will stop as soon as it is modified.

The screenshot explains how to use these functions but the buttons are self-explanatory.

The screenshot displays the Fx702p Debugger P0 Test.702 interface. The top section includes a 'Control' panel with play, step, and stop buttons, and a 'Speed' slider set to '5' (Slow). The main area shows 'Source Code' with 20 lines of BASIC-like code. Below the code is a 'Watch' panel with a search bar containing '\$', and buttons for 'Watch', 'Watch A to Z and \$', and 'Remove'. A table below these buttons lists watched variables:

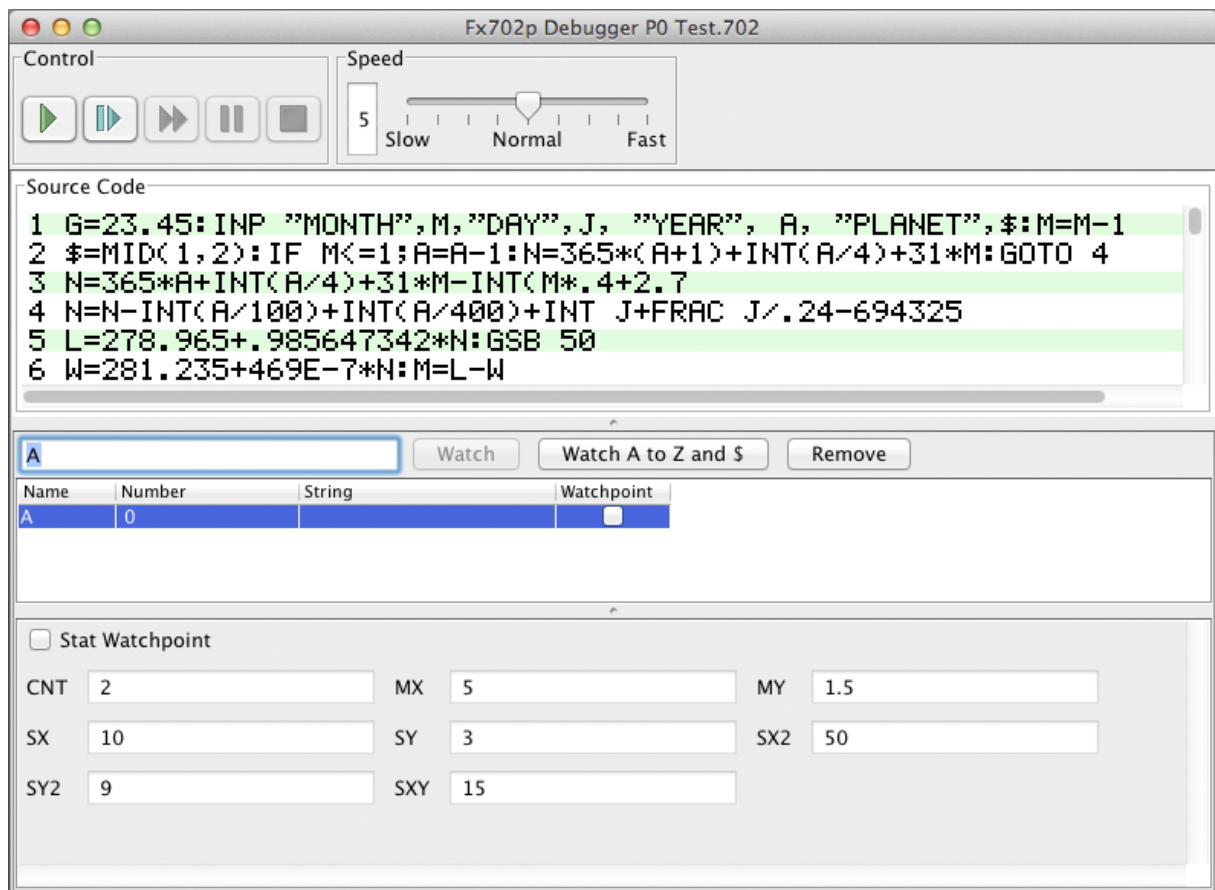
Name	Number	String	Watchpoint
\$			<input type="checkbox"/>
L	0		<input checked="" type="checkbox"/>
N	0		<input type="checkbox"/>

At the bottom of the watch panel is a checkbox for 'Stat Watchpoint'. Red arrows and text provide annotations: 'Watch Variable' points to the '\$' in the search bar; 'Watched Variables' points to the table; 'Stop when this variable is modified' points to the checked checkbox for 'L'; 'Watch all standard variables' points to the 'Watch A to Z and \$' button; and 'Stop watching selected variable' points to the 'Remove' button.

Stat Watchpoints

The debugger can also watch the Stat variables and once they are modified if the "Stat Watchpoint" button is checked.

By default, Stat variables are in an undisplayed split pane. Dragging the separator up will reveal them.



Program Files

As the WRT/Mode 1 mode is not yet implemented, the only way to write program for the emulator is through text files. They must be suffixed with ".702" and like the original Fx-702p tapes can be of two formats: **"simple program"** or **"all programs and variables"**.

Simple Program Format

The format is very simple: just enter the basic lines in ascending order. For instance, a program finding the real roots of a 2nd degree equation will look like:

```
10 INP "A",A,"B",B,"C",C:D=B*B-4*A*C:PRT "D=";D:IF D<0 THEN 10
20 PRT (SQR D-B)/A/2,(-B-SQR D)/A/2:GOTO 10
```

Like the real FX-702p, only uppercase letter are supported.

Should you need some variables to be initialized for the program to run, you can add them before the source code:

```
A=1
B=78
C=64
D=13000
```

```
1 WAIT 0:PRT"***POLARIS***", "*COPYRIGHT A.TONIC*"
2 A=INT(RAN#*600+900:T=INT(RAN#*9+25:G=INT(RAN#*9+1
3 L=0:R=0:V=0:E=INT(RAN#*D+D:P=0:N=INT(RAN#*6+28:S=0:SET F0
```

And you can comment your code. A comment is a entire line prefixed by either // , /* or *

All Programs and Variables Format

The syntax is basically the same as a single program but with a header for the program name, program numbers to separate P0 to P9 and optional passwords.

All programs: "UTILS2"

P0

Password: "0"

```
1 INP "A",A,"B",E,"N",N:FOR Z=1 TO N:C=(A+E)/2:B=(A+C)/2
2 D=(C+E)/2:X=B:GSB 10:F=Y:X=C:GSB 10:IF F>Y;E=C:GOTO 5
3 F=Y:X=D:GSB 10:IF F<Y;A=C:GOTO 5
4 A=B:E=D
5 NEXT Z:X=(A+E)/2:GSB 10:PRT "T=";X,"MAX F=";Y:GOTO 1
15 RET
```

P1

```

1 INP "A",A,"B",B,"N",F:X=A:GSB 10:E=Y:D=(B-A)/F/2
2 FOR I=1 TO F:X=X+D:GSB 10:E=E+Y*4:X=X+D:GSB 10:E=E+Y*2:NEXT
I:Y=B
3 GSB 10:E=E-Y:PRT "I=";D*E/3:GOTO 1
15 RET

```

P2

P3

P4

P5

P6

P7

P8






P9

Breakpoints and Watchpoints

When saving from the emulator, you can also add your breakpoints and watchpoints in the file. They will be at the end of the file in a text format. You should not edit them manually.

Key mapping

The Fx-702p keyboard and display use special keys not found on an Ascii keyboard. To enter them in a program, you will have to use the following mapping:

	<= or \<
	>= or \>
	<> or \=
	PI, p, \p or \P
	e, \e or \E. E alone can be used in a number.

Not implemented (yet)

Several functions are not implemented because I do not need them or I had no time to work on them, and because the emulator as-is allows me to reach my goal: rerun my good old planets position program... Obsolete but so satisfying.

So here is what is missing in no particular order:

- Support for the WRT mode. This one would be nice but of course, using a modern text editor to manage to .702 files is more convenient
- Saving the memory in a file to emulator permanent memory
- Computing the size a program would use on FX-702p hardware to display the remaining step and support full DEFM limits
- Supporting the 80 characters limits on a line with automatic spaces removal
- Supporting GSB and FOR loops imbrication limits
- Implementing LIST and LIST ALL
- Trace Mode
- Generating an error in Prt Mode
- Implementing LOAD, SAVE, VER, PUT et GET
- Support for the ROM instruction

Stuff dreams are made of

Other functions would be nice but I seriously doubt I will have time to ever work on them:

- A Reset button
- An FP-10 printer emulation
- An FA-2 tape interface emulation
- Some GUI improvements