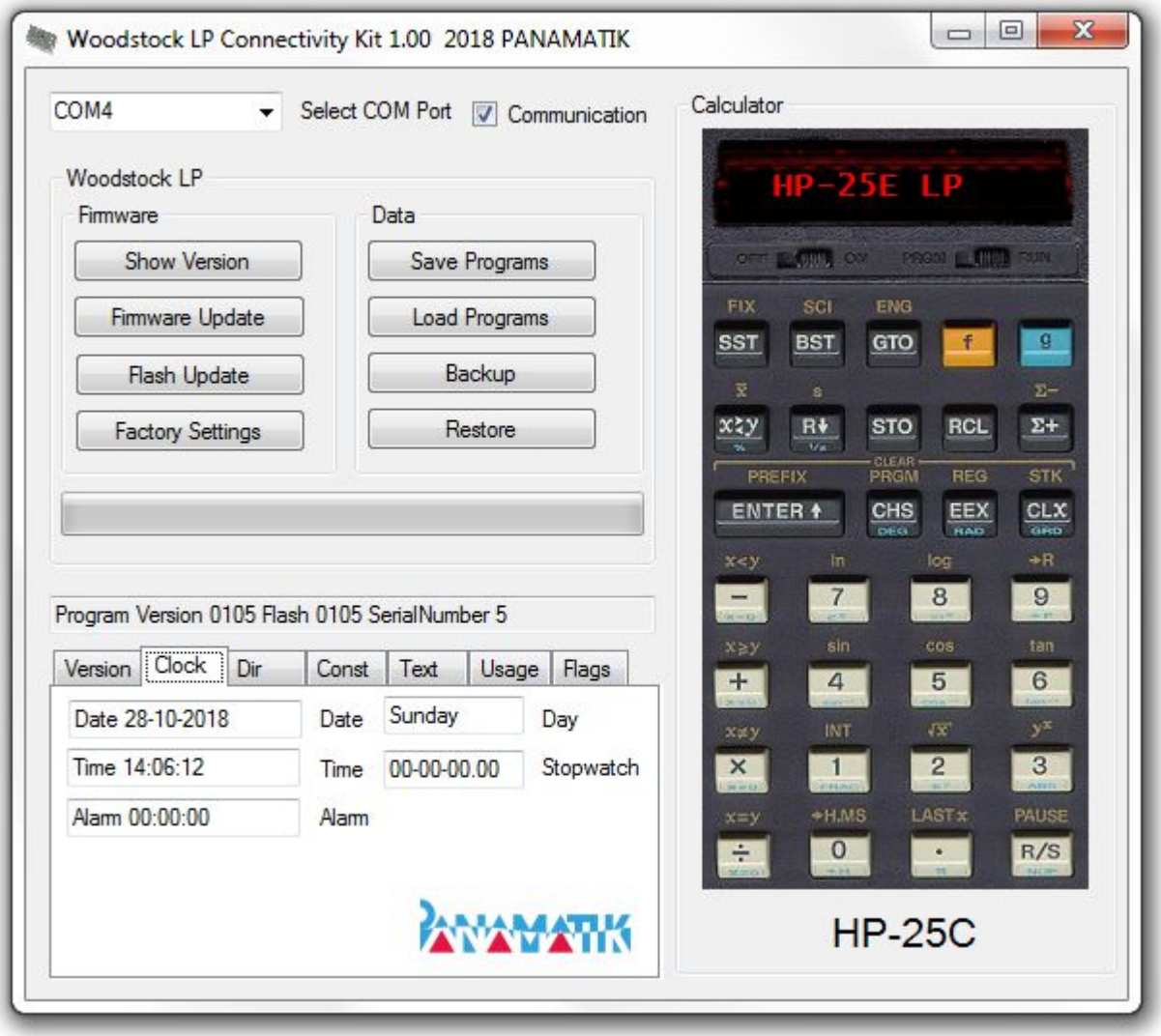
Woodstock LP Connectivity Kit
User Manual



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Bernhard Emese , June 2020, Rev. 1.05

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Rev 1.00 April 2019 Initial release
Rev 1.01 May 2019 HP-67 Mnemonics corrected

Rev 1.02 May 2019 PC Emulator added
Rev 1.03 Oct 2019 Comment entry , Program Flow, Version 1.03 new features
Rev 1.04 Nov 2019 Assembler writing your own ACT Code
Rev 1.05 June 2020 PC Emulator removed, moved to „ACT Analyzer“ application

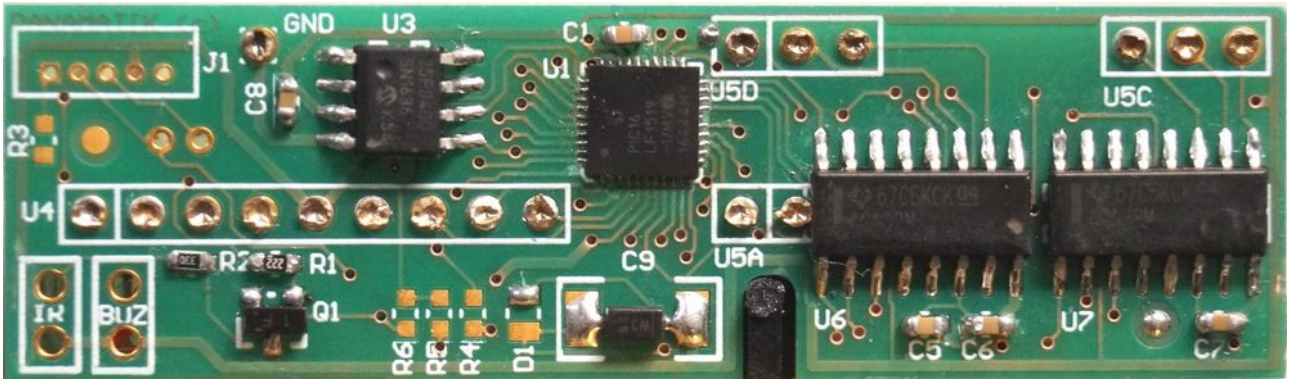
1. Introduction

The „Woodstock LP circuit“ is the ultimate upgrade and repair kit for your Woodstock calculator. It contains all Woodstock and Spice models and most of the Classics too. But it has even more capabilities in conjunction with this PC application. This manual describes the HP LP connectivity kit, which allows you to communicate with your LP calculator and save and restore your programs and much more.

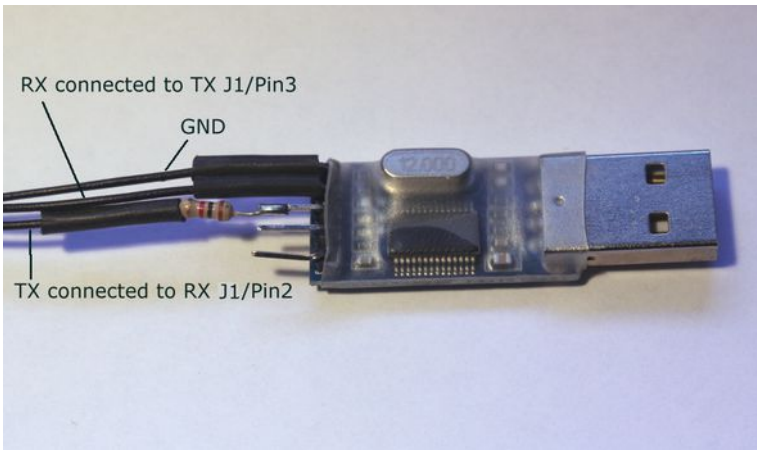
The Woodstock LP calculator can be used standalone or together with the HP LP connectivity kit. The application establishes a connection between the Woodstock LP calculator and a Windows PC. With this connection it is possible to update the firmware or to backup and restore your data. The application is very easy to use and pops up as a dialog when started.

The application is running under Windows XP/7/Vista/8/10 using the MicroSoft .NET framework version 3.5. This framework is preinstalled in Windows 7 and later, you have to download and install the framework when using the Windows XP operating system. You need at least one COM Port by inserting an USB/RS232 TTL 3.3V converter.

2. Connecting the LP calculator.



For connecting the calculator you need the LP connection cable. It is an USB/TTL RS232 3.3V converter with three wires and a small 5-pin connector at their end. It must be connected to J1, which you can see at the top left of the image. Pin 1 is the quadratic pad on the far left.



USB/RS232 TTL converter LP connection cable

I recommend to solder an 1k resistor between TX and J1/2, which protects the RX receive pin of the LP circuit in case the converter produces a higher voltage than your battery.

I do not recommend to power the LP circuit from the converter with an additional VCC wire, I prefer using the battery. Of course, if you stay connected for many hours the calculator will not enter sleep mode and the battery will go down, but it will be discharged only after 100 hours.

Don't use the simlar „new ACT“ update cable, which has 5 wires. It will damage the PIC processor of the LP circuit, because it uses 5 volt and the Low Power needs only 3.3 volt.

If you open your calculator and remove the LED display you will see the LP circuit and the connector J1 with 5 small pin holes in the upper left corner. Here you have to insert the connection cable plug. Don't solder the cable plug into the circuit, there is no space for it. While updating,

which normally needs only one minute, you can put the connector into the holes and press slighty with your thumb to establish the connection, while the data transfer is accomplished. For getting contact, the right way is first to switch on the calculator, then insert the cable to the J1 connector.

If you think to connect the circuit more often to load and store your programs from/to PC, then it could be advisable to apply a connector to the calculator housing or at least to provide a connetor inside, which is soldered to the J1 connector by 3 wires. In this case it is possible to leave the LED display in place during communication.

If the calculator has entered sleep mode, no communication is possible and you have to wake up the calculator by pressing the DIV button. But if you have activated the connection check box, the calculator will stay awake as long the application runs and pressing any button will of course retrigger the sleep time.

J1 connector pinout

Pin	Name	Remark
1	MCLR	Master Clear (not used, resets the circuit if low)
2	RX	connect to transmit line of converter (3.3V level)
3	TX	connect to receive line of converter (3.3V Level)
4	VCC	3.3V (not used if circuit is powered by battery).
5	GND	Ground

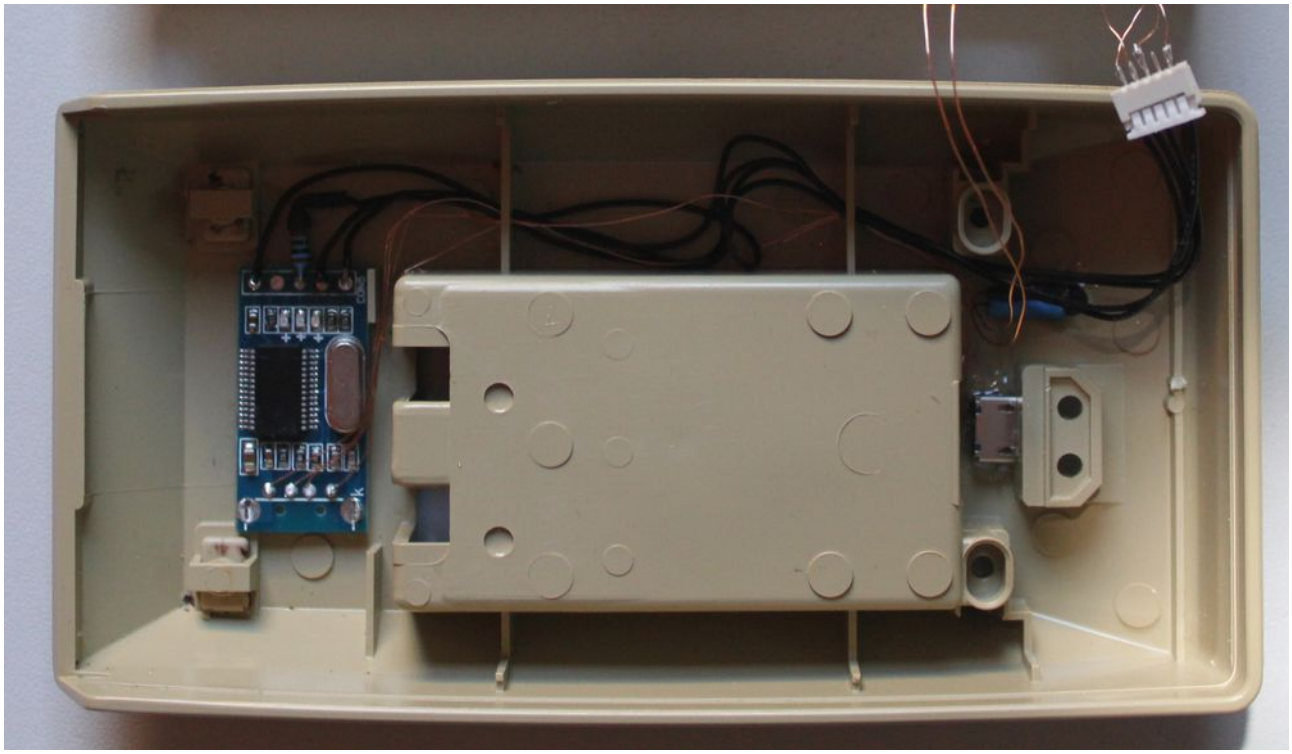
Three wire connector

When you decide to install a connector to the housing of the HP calculator a 3-pin head phone jack is a good choice. Or just use pins of a socket strip as shown in the image below as a connector. You can install it in the front of the calculator and then you can always plug in your cable, whenever you like. Use one pin for coding to prevent plugging in the connector reversed!

LP connector

Micro USB connector

It is also possible to integrate the USB/RS232 converter together with a Micro USB connector into the LP calculator as shown in the image below.



Whenever you plug in the USB cable, you have connection to the LP circuit without openig the calculator. However it is rather difficult to attach the four USB wires to the Micro connector, because it has very tiny contacts. The connector must then be fixed by two component Epoxy glue. The USB pins of the USB converter have to be removed and four copper wires must be soldered between the USB port ad the converter, and three wires GND RX TX must then be soldered to the LP circuit J1 as described above.

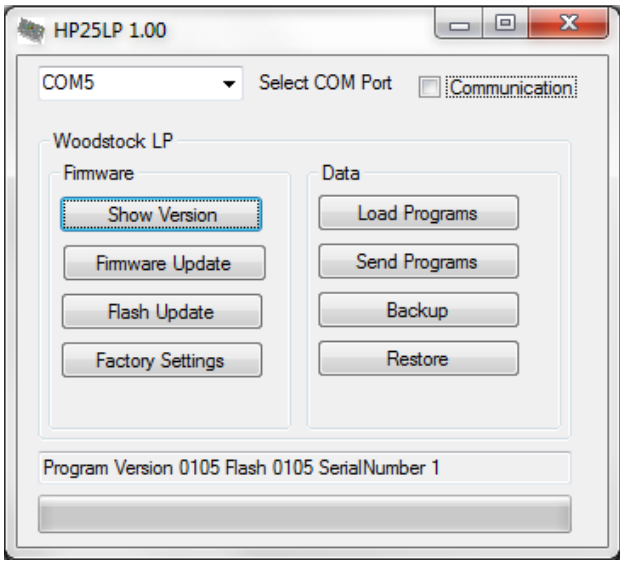
Once this is done the LP calculator is the first ever red LED calculator with an USB interface !

3. Selecting the COM Port

Before starting the application you have to plug in the USB cable, then the COM port is available to the system. You have to select the COM port of your plugged in USB connection cable. The combo box on the top left shows all available COM ports of your computer and you have to select the right one. If you have already connected the cable to your LP circuit, the application tries to communicate with the LP circuit by the last COM port in the list and if successful shows the version info in the message field. As soon as the communication is established, also the greyed buttons become available.

4. Show Version

After the COM Port is found you can show the software version by pressing the associated button. You will see the result in the message below the buttons.



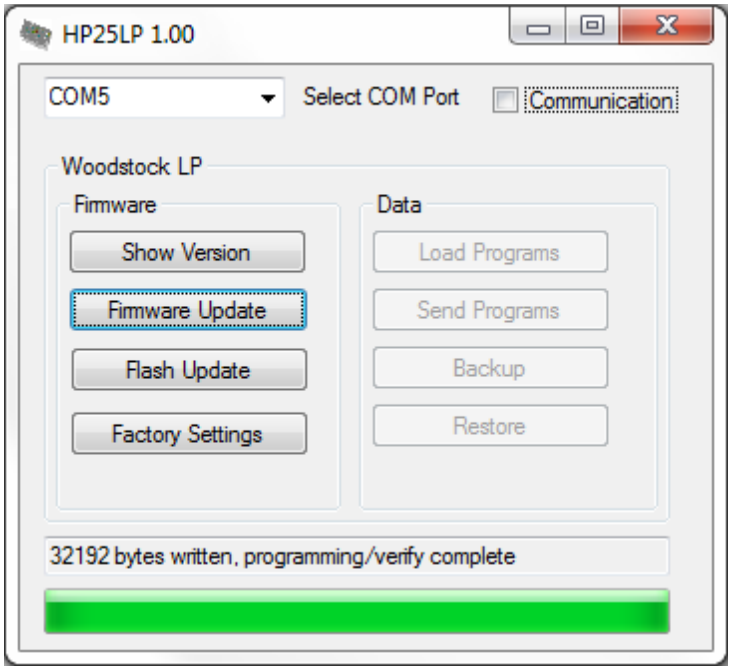
There are two sections with data in the LP circuit, the PIC program, which is the firmware, and the contents of the 512k flash memory, which contains the user programs and data registers of all calculator models.

If you click „Show Version“ the PIC program version will be shown followed by the flash data version and last but not least the serial numer of your LP circuit.

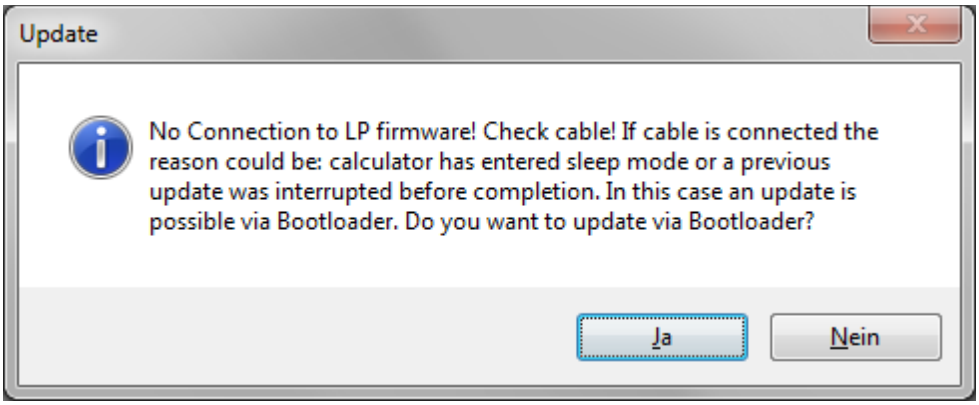
In the early LP firmware version prior to 1.05 , there were no PC readable version number included, don't bother if FFFF or something else is shown instead of a correct version number. After your first update this will be corrected.

5. Firmware Update

This button opens a file dialog, where you can select an update file. The update file is named „HPLP105.act“ or similar, containing the version in its file name. When a correct file is selected, the update starts immediately and the progress bar at the bottom shows the progress, which normally needs only 10 seconds to complete. After the update is done you will get a message, how many bytes are written, which normally is 32k bytes, the complete PIC program space memory.



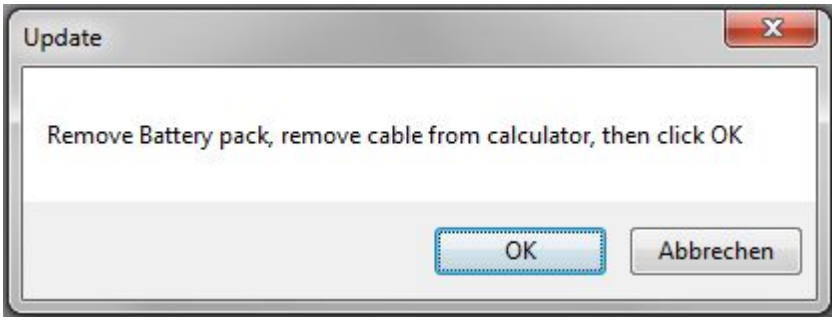
Before opening the file dialog, the application checks, whether it can communicate with the LP. If not it pops up a dialog and tells you first to check the cable. If the reason is sleep mode, then wakeup the calculator, or, if you have no keyboard attached, remove the batteries for some seconds.



There are two ways to perform the update. The above described is the simple way, which always works if the communication is established.. The second method is an update via bootloader. There can be circumstances, i.e. when a previous update was interrupted half way and the firmware is no

longer complete, when the LP circuit cannot communicate any longer.

However even in this case an update via the integrated bootloader is still possible, but the procedure is more complicated. We first have to enter the bootloader. This is done by following the instructions on the screen.



It is important to plug in the update cable to the J1 Connector AFTER the first dialog is closed. The RX line will held low to indicate the bootloader to wait for data instead of jumping to the firmware. If you close the last dialog the file dialog pops up and you can select your update file. The USB cable remains connected to the PC.

After the firmware update is complete, the display shows all digits as 8's blinking, which indicates that the calculator is still in bootloader mode. You have to restart the calculator by disconnecting the power (removing the battery pack).

The newer bootloader version 1.12 of the LP circuit shows, instead of all 8s, the actual bootloader version. Please note that it is not possible to replace the bootloader by the firmware update.

6. Flash Update

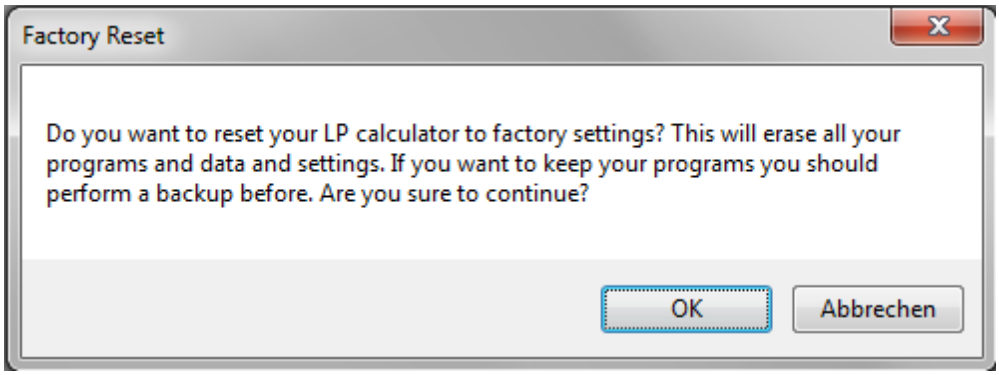
Normally after the firmare update is done, also a Flash memory update is necessary. This will update the data written in the 512k Flash memory chip (SST25). The contents of the Flash memory must correspond with the firmware. But no worry, even if the flash memory is totally cleared or corrupted, you will get communication with the firmware, but the LED display will possibly show nothing and the calculator is not running. The easiest way is to restore to factory settings, but if you want to preserve your user programs and settings, you can choose an Flash update file. A file dialog will pop up and you should select the proper binary flash update file, which is named „HPLPflash105.bin“, depending on the version.

Updating the flash memory will not overwrite your programs or register data and personal preferences like your Welcome text. It will update only data which is necessary to run the LP firmware. This needs about half the available Flash memory. The flash update needs about one minute to complete.

After having updated both, your calculator and the Flash memory, the „Woodstock LP“ is renewed and should run the newest firmware.

7. Factory settings

You can restore the factory settings if you press this button. This will erase all your programs and data. Therefore you will be able to cancel this operation before execution.



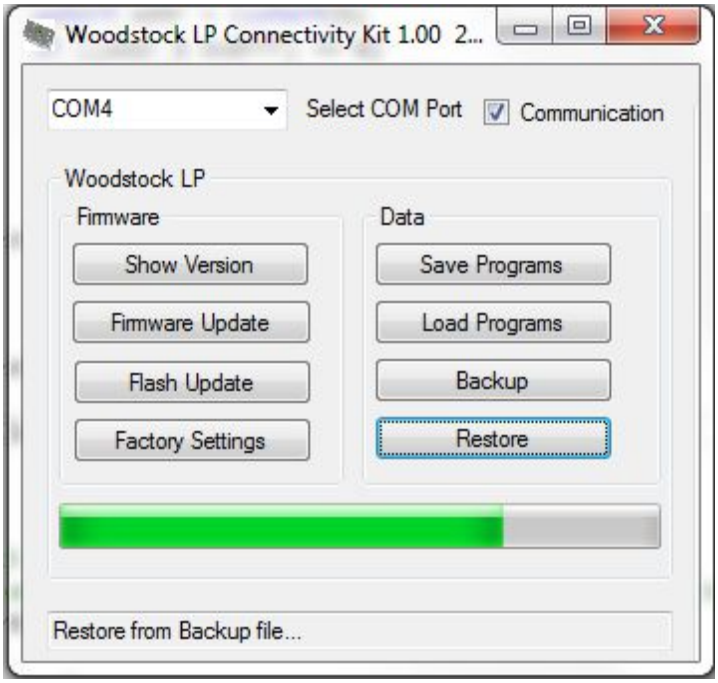
The operation will last some minutes, because all data in the 512k Flash memory will be erased and reprogrammed. It is advisable to backup your programs before programming the factory settings.

8. Backup

This button saves the complete calculator state to file, including all your programs and data and the „Continuous Memory“ of all available calcaulators. Saving the calculator state needs about one minute to complete. The file size is 192 kbyte. Its default extension is „*.wlp“ for Woodstock LP.

9. Restore

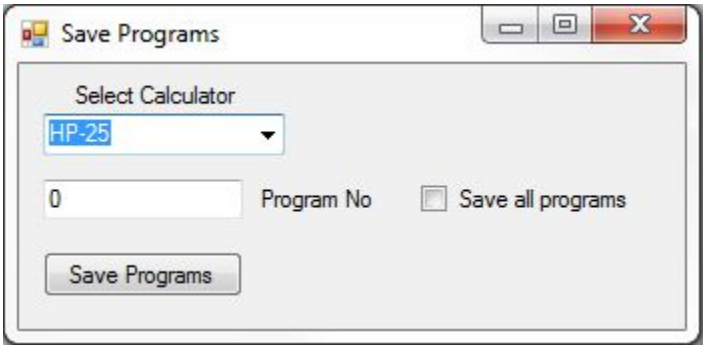
If you have backuped your LP programs and registers you can restore them by this button. A file dialog will allow you to select the .wlp backup file you have stored. Restoring needs one or two minutes, you will see the progress by the progress bar.



There is a default „ClearMemory.wlp“ file available, which clears all your programs and data.

10. Save Programs

You can select a calculator and save a single program or all its programs to a human readable ASCII text file. This simplifies householding of a program collection. You can use any PC printer to print your programs to paper. And you can edit the program and load it back into the calculator.



The following text is an example of a small test program, which has been saved to file. The name of the programs is „COUNTER“

```
HP25

PROGRAM 100
NAME COUNTER

01  1
02  +
03  PAUSE
04  GTO 01

END
```

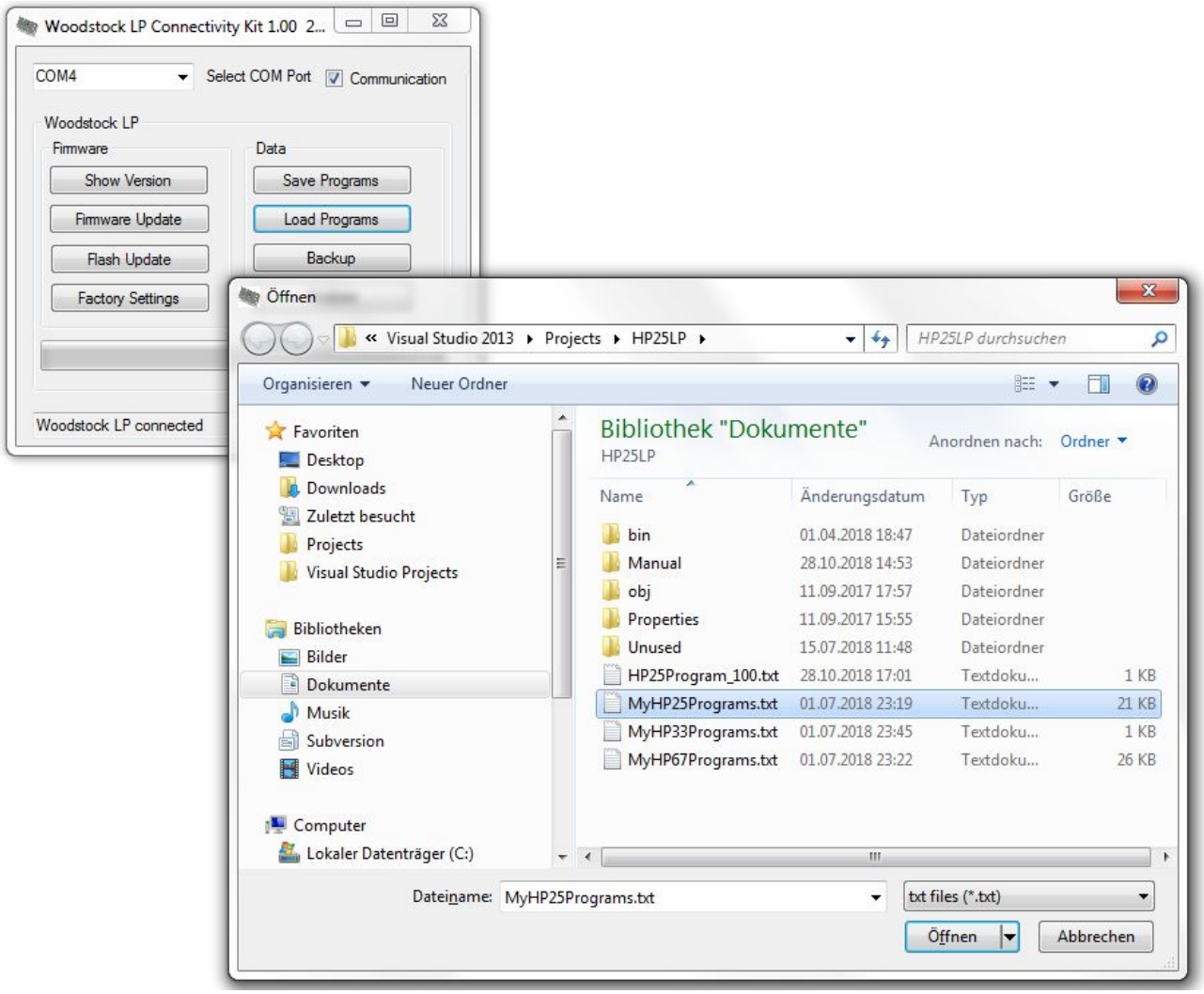
The HP-25 programs which are stored by f STO . 00 - f STO . 99 are numbered from 00 to 99 as expected, but the fast access programs f STO 0 to f STO 9 are numbered from 100 to 109. And the HP-25 program collection, which can be loaded by f f RCL .00 - f f RCL .55 or any other calculator program collection is numbered from 110 upwards. The example above can be loaded with f RCL 0.

11. Load Programs.

This is the inverse of „Save Programs“. This button will allow you to load either previously saved programs or to load your own handwritten user programs.

Writing programs with a text editor is more comfortable than entering a program using the calculators buttons. Here „Load Programs“ comes in. You can transfer individual programs or an entire collection of each calculator from PC to the LP circuit. The progams are simple ASCII files, written by a text editor.

The Syntax has some rules. If you use instructions with arguments, the arguments must be separated by exactly one space character like „STO + 0“. The line numbers are irrelevant but must be present, the lines are read sequentially. If you remove or add a line you don't need to correct the line numbers or you can set all line numbers to 0 or 1. Between the line numbers and the instructions there may be one or more whitecharacters. You can insert comment lines, which are marked by a semicolon as first character. And you can add comments after each instruction (since Version 1.02)



An example of a small program for the HP-67 is shown here:

```
HP67  ; this specifies the program is for the HP-67 calculator

; example program for HP-67

PROGRAM 0
NAME COUNTER

000  LBL 1  ; this label marks the begin of the program
000  1      ; add one
000  +
000  PAUSE  ; show the result in the display
000  GTO 1  ; jump to begin of loop

END         ; end of COUNTER
```

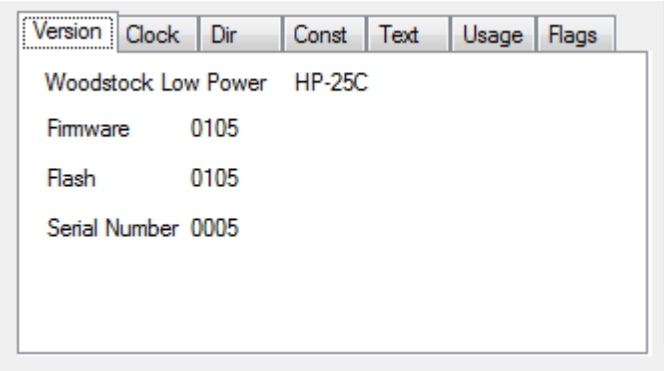
Each Program file starts with the calculator type, HP67 in the above example. All following programs are written for this calculator. The program number can be individually defined and can be in any order.
Each Program is enclosed by the keywords PROGRAM and END. In case of HP-67 programs A maximum of 224 program steps are allowed. There will be an error message if the syntax is not correct for the given calculator or the number of steps exceeds its maximum. The line numer in which the error occured is shown.

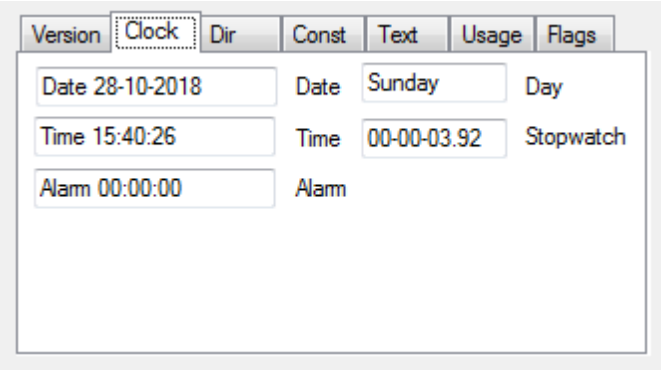
When you use comments like in the example above, be aware, that the comments are not transmitted to the LP circuit. And if you save the programs later from the LP calculator you might not want to overwrite the same file, because the comments would be lost. Just choose another file name to keep your comments.

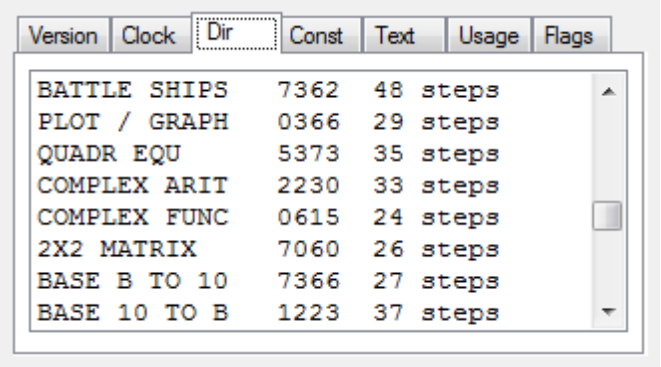
[1] For now only HP-25, HP-29 HP-33 HP-34C and HP-67 programs can be loaded. See Appendix for Mnemonics.

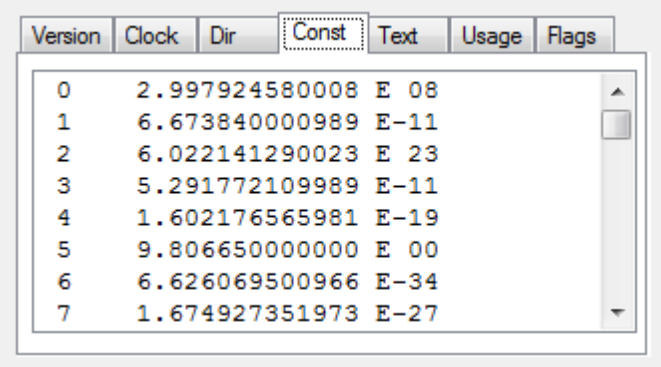
12. Tabs

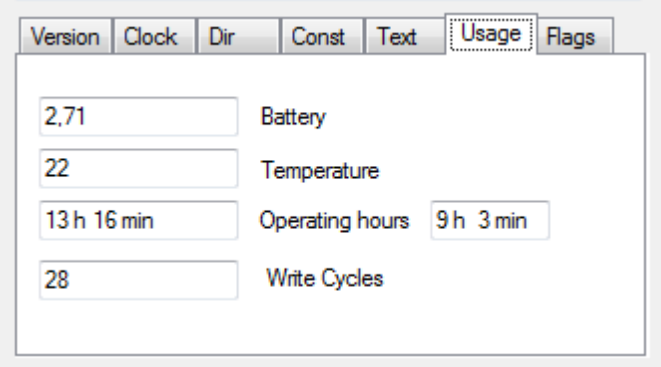
If you have successfully done the update to version 1.05 or higher you can enlarge the window vertically, and you will discover a tab field, which shows actual data from the calculator. In most tabs you cannot enter values, they show the time, the program directory, your constants and much more, if you press the corresponding tab. But you can enter your user text string and change the actual flags of the calculator.

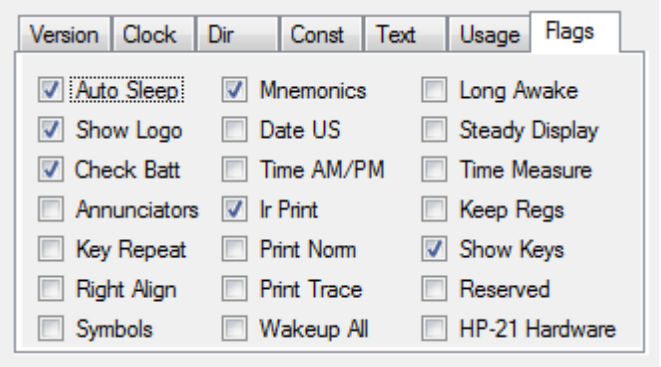












Version

This tab shows the actual running calculator type, the PIC firmware version, the 512k Flash Data version and the serial number of the LP circuit. If you haven't updated the firmware to at least 1.05 you probably can't see the correct firmware version, reading the version num ber was not implemented in earlier versions.

Clock

The Clock tab shows the actual date and time and the running stopwatch. If the stopwatch is running in the background it will not be updated in the display. The reason is that the stopwatch display will only be updated in the calculator, when it is displayed. This saves calculator time.

Dir

This shows the directory of your user programs. A list of all program names and the size will be displayed. If a library location is not used, it is marked as empty.

Const

This shows all 100 constants of the LP calculator. which can be accessed by most of the calculator models. 20 of them are preset and cannot be changed.

Text

You can display and enter your personal text. Only capital letters are allowed.

Usage

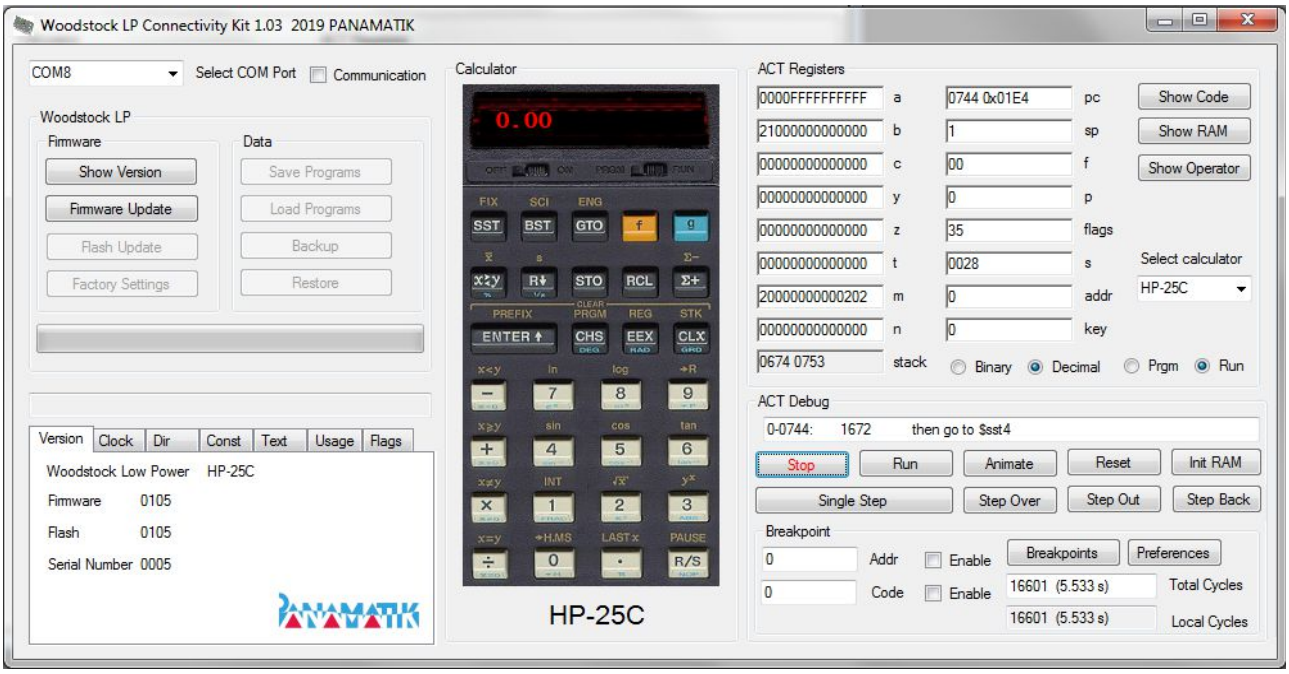
This tab shows the Operating Time and Flash write cylces. Also the actual battery voltage and temperatur (only roughly estimated) is shown.

Flags

The Flags can be set and reset to enable/disable special features. See the description in the LP manual for more info about these flags.

13. In Circuit Debugger

If you have successfully done the update to version 1.05 or higher you can use many more functions of the application and you can remote control your LP calculator. Enlarge the window to the right and you will discover an image of the calculator and many new buttons and entry fields. What you see in the middle part is the remote control panel of the calculator. First have a look to the „Communication“ check box. If it is not activated you can activate it if the LP circuit is connected, then the calculator display will be shown on the real calculator and on the screen as well. All buttons, which you press on the real calculator, will be executed and the result is also shown in your window, but also the buttons you press in the window, will be executed. You can do your calculations remote controlled.



On the right side you see the internals of the calculator, the ACT registers. With the corresponding buttons you can single step or run partially through parts of the ROM program of the calculator.

This is not a simulation, but the real calculator will be single stepped. This part of the connectivity kit is called the „In Circuit emulator“, it is valid for all Woodstock and Spice Classic and the HP-67 calculators. The register description is far too extensive to be described here. The register usage differs from calculator to calculator. and it is an adventure to understand how the calculator really works while analyzing key strokes and perform arithmetic or trigonometric functions.

All registers can be manipulated by entering new values, when the calculator is stopped. There are three possible states: Stopped, Running and Animate. When the calculator is running it is executing all functions in real time. In Stop mode it waits for the next button, which can be a single instruction step or performing a complete Subroutine „Step Over“ or the remaining part of a subroutine until a return instruction will be found „Step Out“. Animate differs from Run in that way, that after each instruction the registers will be displayed. this is very slow compared to RUN mode, but shows very nicely how the register contents changes with each instruction.

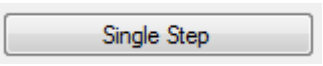
The text field above the buttons shows the next instruction which will be executed, it contains the address, the instruction code and, if present, also your comments. After executing a single step or a subroutine, the register contents are displayed and if some of them has changed they are displayed in **red text**. Registers that didn't have changed are displayed in black. Thus you can easily see what's going on.

„Reset“

The „Reset“ button stops the calculator and sets the program counter pc to 0000. Here you can start your investigation and see how the initialization routine of the calculator is performed.

„Init RAM“

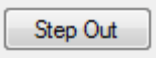
This will reset the Continuous Memory of the calculator to all FFs (all bits set), or the value you have choosen in the preferences. This simulates the calculator state as if a new battery is inserted and some of the models will show „Pr Error“, indicating that the „Continuous Memory“ contents is lost.

„Single Step“ 

Pressing this button will execute a single HP machine instruction. You will see the new register values if any of them have changed. The program counter pc increments by one or jumps to a new location.

„Step Over“

Executes the complete subroutine if the program counter is located at a JSB instruction, otherwise a normal single step is executed like pressing the „Single Step“ button. The „Local Cycles“ counter is reset before the JSB instruction is executed. If the program counter does not point to a JSB instruction a normal Single Step is performed.

„Step Out“ 

Runs the HP machine code within a subroutine until a RETURN instruction is executed. This will stop execution after at the end of the subroutine. The „Local Cycles“ counter is reset before execution.

„Breakpoint“

You can define a breakpoint for executing the HP machine code until a specific address is encountered. Enter a 12-bit breakpoint address as octal number. If enabled with the checkbox, the execution will stop when the program reaches the address when program counter and breakpoint address matches.

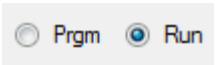
„Code Breakpoint“

You also can define a code breakpoint. Enter an 10-bit instruction code as octal number. Then press

„Run“. If the breakpoint is enabled the execution will stop as soon the executed instruction and the code breakpoint matches.

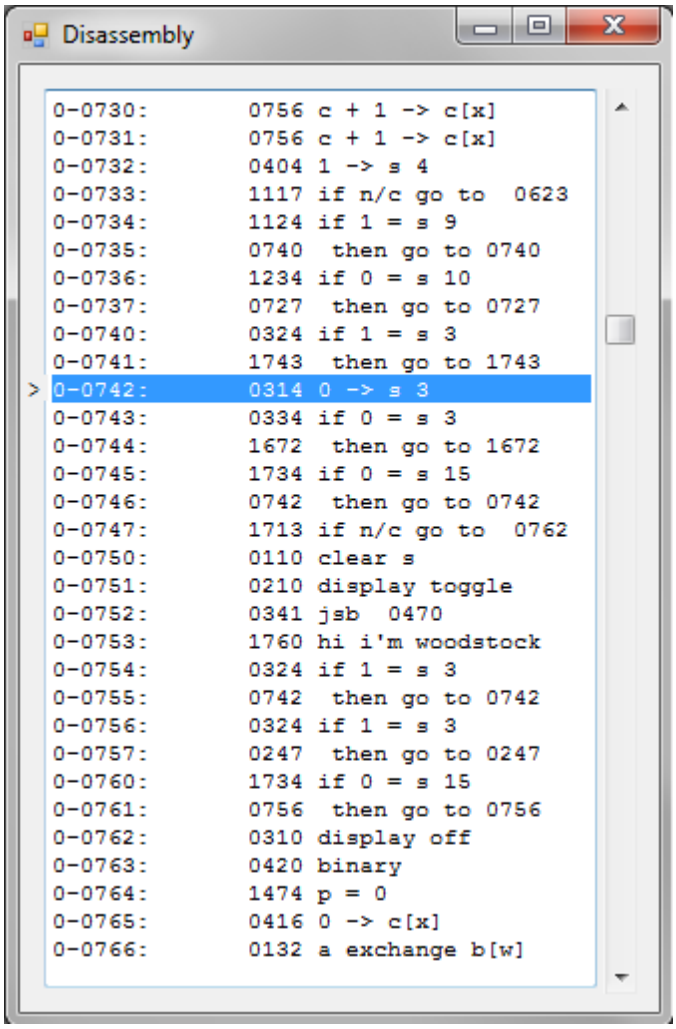
„Binary Decimal“

This bit is also part of the ACT chip, it changes when the „binary“ or „decimal“ command is executed. It can be altered like the register contents can be changed.

„Prgm Run“ 

This changes from Program to Run mode and is the same as using the PRGM/RUN slider switch.

14. Disassembly Window



To understand the program flow you need to see the disassembled instructions. This is done by clicking „Show Code“. A window with the instructions around the actual program counter will appear. You can enlarge or reduce the window size to your needs. Whenever you stop the calculator or during „Single Step“ or single step „Animation“ the actual program counter address, instruction code and mnemonics of the instructions will be shown.

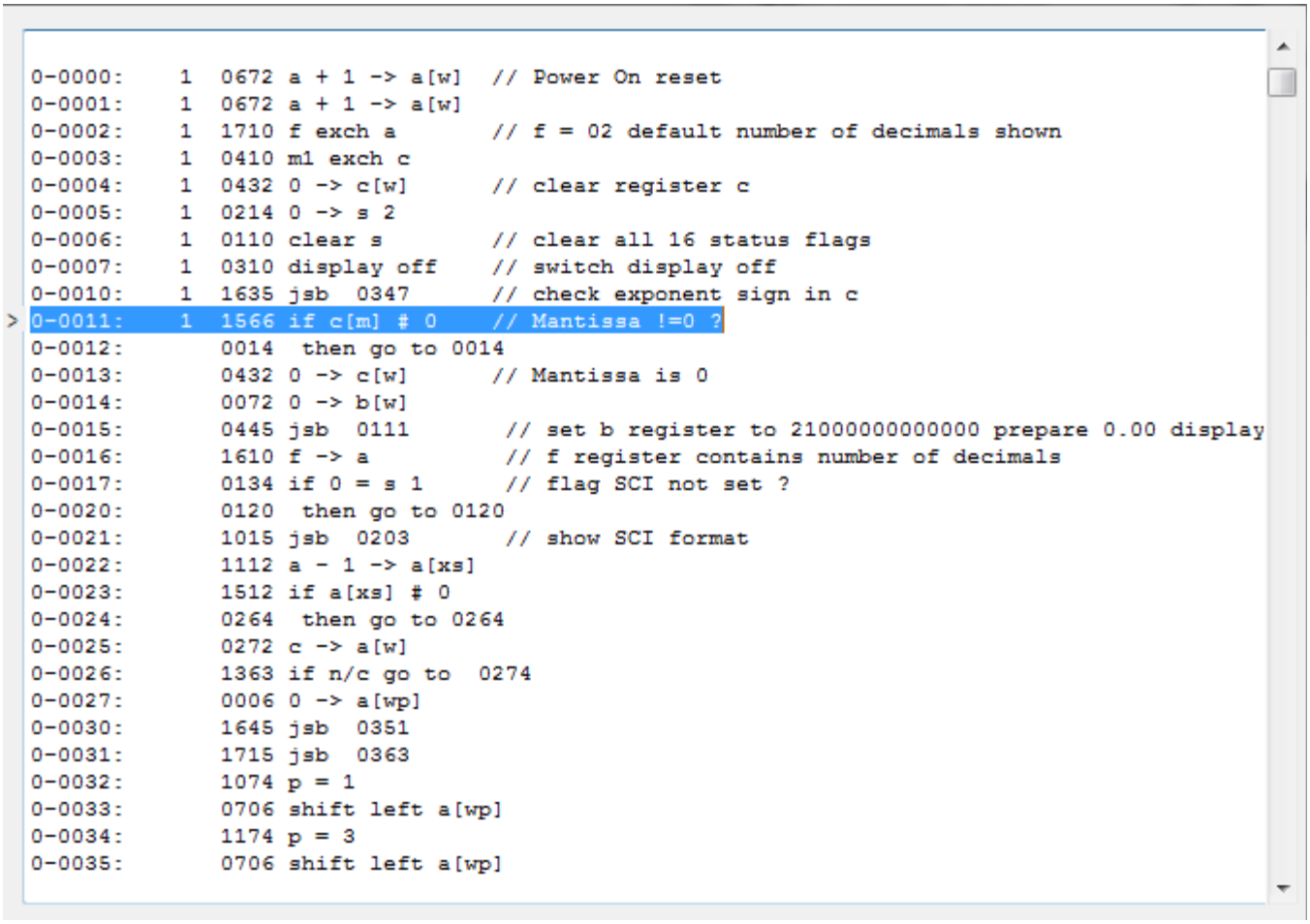
The next instruction line, that will be executed is shown in blue color and marked with an arrow character.

The left column shows the address of the instruction in octal notation. The preceding number is the actual ROM Bank. Each ROM bank ranges from 0000-7777 octal, which is 4k bytes or 12-bit. There is a theoretical maximum of 16 banks possible, which would allow a maximum of 32k ROM code. The HP-34C, the biggest model in our selection, however uses „only“ 8k.

The next column shows the 10-bit instruction code in octal notation. Notice, that there are no digits above 7 used. The right side of the window shows the mnemonics of the instructions. What you see in the window is a text file named „rom_25.dis“ for the HP-25 calculator. Every calculator has an assiciated text file, which you can edit with a text editor if you like. You can add your remarks in each line and they will be shown the next time in the application. But beware to remove or add lines whe using an exteral editor, the executed instructions will not match any longer the text lines. Better to use the comment entry described below, which prohibits to insert or delete lines.

14.1 Comment Entry

When you are analyzing the calculator firmware you want to enter line comments. This is easily done just by entering your text behind each line. It is not possible to overwrite or remove the address and opcode, but any text at the right can be entered. You can even remove the Mnemonic code and replace it by your own text, but this is not advisable.



```
0-0000:    1  0672 a + 1 -> a[w]  // Power On reset
0-0001:    1  0672 a + 1 -> a[w]
0-0002:    1  1710 f exch a       // f = 02 default number of decimals shown
0-0003:    1  0410 m1 exch c
0-0004:    1  0432 0 -> c[w]      // clear register c
0-0005:    1  0214 0 -> s 2
0-0006:    1  0110 clear s        // clear all 16 status flags
0-0007:    1  0310 display off    // switch display off
0-0010:    1  1635 jsb  0347      // check exponent sign in c
> 0-0011:  1  1566 if c[m] # 0    // Mantissa !=0 ?
0-0012:       0014  then go to 0014
0-0013:       0432 0 -> c[w]      // Mantissa is 0
0-0014:       0072 0 -> b[w]
0-0015:       0445 jsb  0111       // set b register to 21000000000000 prepare 0.00 display
0-0016:       1610 f -> a          // f register contains number of decimals
0-0017:       0134 if 0 = s 1      // flag SCI not set ?
0-0020:       0120  then go to 0120
0-0021:       1015 jsb  0203       // show SCI format
0-0022:       1112 a - 1 -> a[xs]
0-0023:       1512 if a[xs] # 0
0-0024:       0264  then go to 0264
0-0025:       0272 c -> a[w]
0-0026:       1363 if n/c go to  0274
0-0027:       0006 0 -> a[wp]
0-0030:       1645 jsb  0351
0-0031:       1715 jsb  0363
0-0032:       1074 p = 1
0-0033:       0706 shift left a[wp]
0-0034:       1174 p = 3
0-0035:       0706 shift left a[wp]
```

Example of HP-21 code with comments entered.

If you close the window you will be asked, whether the comments should be saved to file. This will overwrite your original .dis file for this calculator. If you want to keep the original you should make a copy before.

14.2 Program Flow

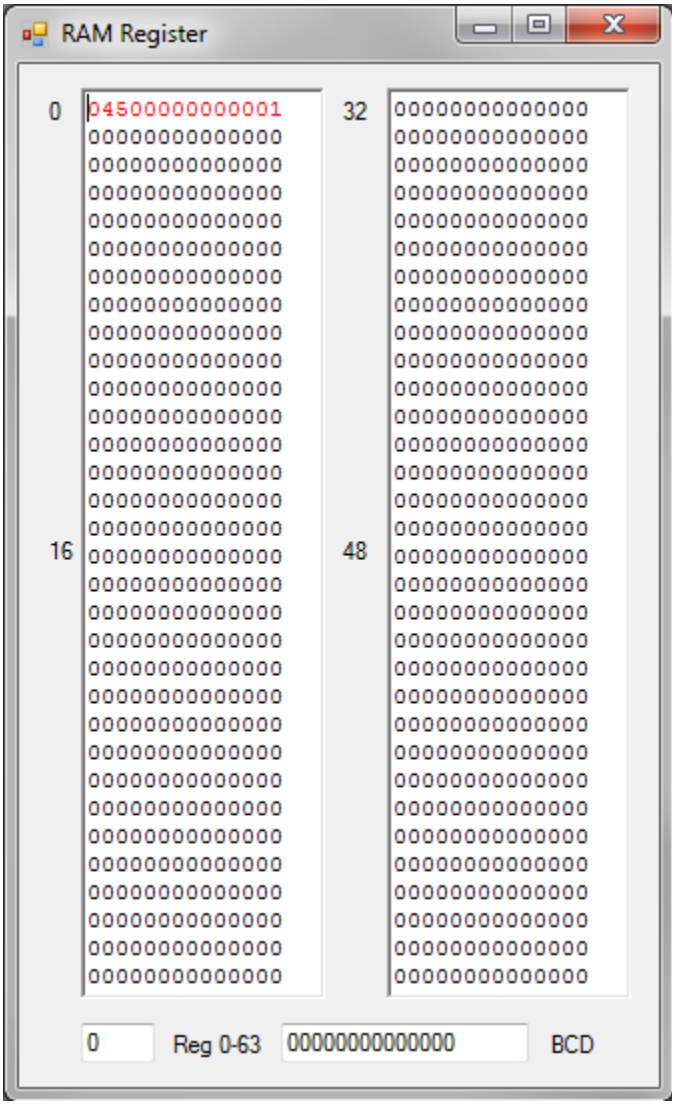
If you run the calculator code, either by Single Step or Run, a number is shown after the address, which shows you how often this line was executed. This gives you information about which lines are used by the program or how often a loop is executed. If a line is executed more than 10000 times, „>9999“ will be shown. This is normally the case in the „wait for keyboard entry“ loop.

15. RAM registers

As some models have additional RAM, which in fact is true for all models except HP-21, you can also show the RAM contents by pressing „Show RAM“. A window with 64 registers, the maximum amount which only the HP-34 and HP-67 can provide, are shown. This window shows the actual register contents, for some models this is the „Continuous Memory“, for others it is just the volatile registers. Please note, that the HP-25 has only 16 registers, only the left upper part of the window will change if you store a 49 step program or store variables in the 8 registers.

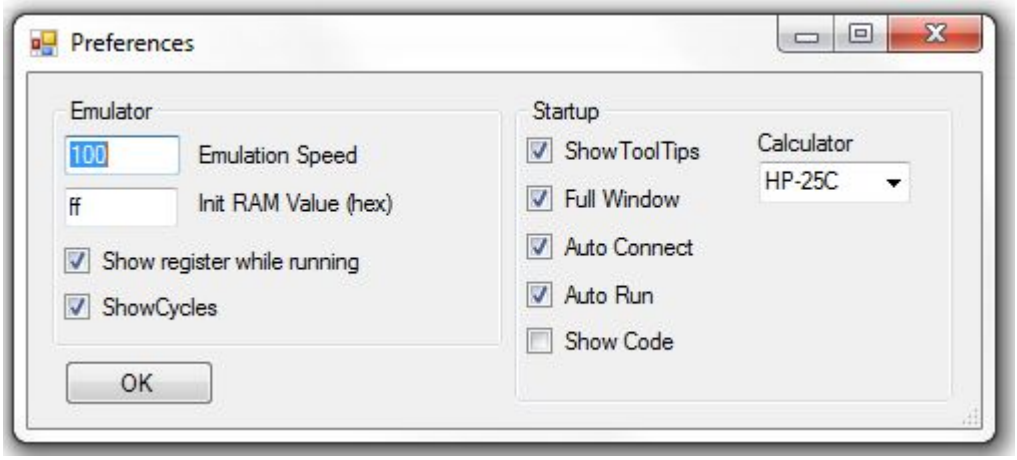
Whenever a register value has changed since the last step of the program it will be marked in red color. This makes it more easy to follow any changes.

You can also manipulate the register contents by entering a new value. Enlarge the window at the bottom and you will see the entry fields. First chose the register number then enter its value.



16. Preferences

By clicking the „Preferences“ Button a dialog appears to enter some convenient personal likings.



The Emulation speed is a number between 1 and 1000. It determines how many machine cycles are executed before any display refresh is done and makes the calculations faster or slower. Normal values are between 50 and 500.

The Init Value will be used when you fill der RAM registers with a value by the „Init RAM“ button. Any value between 00 and ff can be entered as hexadecimal number.

„Show registers while running“ refreshes the registers while the calculator is running. Deactivating avoids continuously changing values on the screen.

More preferences affect the behaviour at startup.

Each button has a small text to explain its functionality. You can activate it by „Show Tool Tips“

When „Full Window“ is activated the program starts with the Calculator and Emulator fields visible.

„Auto Connect“ tries automatically to communicate with the LP circuit at startup by selecting the last found COM Port in the list of available serial ports.

„Auto Run“ starts the selected calculator at startup and **„0.00“** will automatically appear

„Show Code“ opens the disassembly window automatically.

When you press the OK button the preferences are saved to file „HPLP.prefs, which is automatically loaded at startup. If you close the dialog without saving your entries are discarded. If no preference file is present default values are used.

16.1 Save

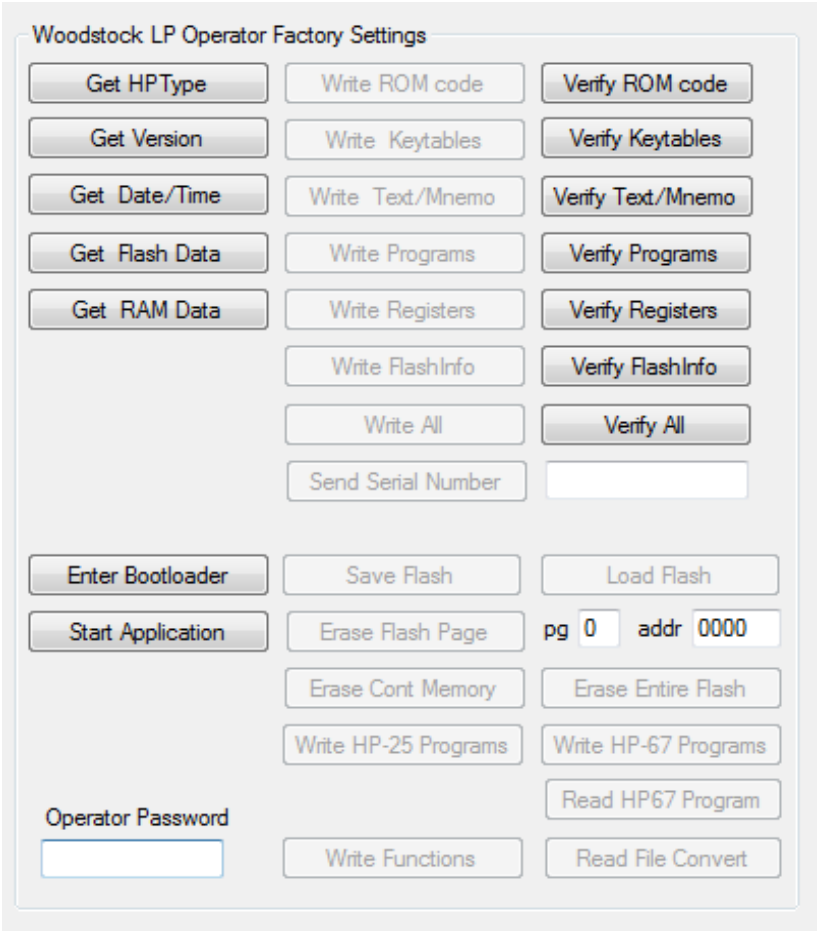
If you want to save your session use this button and the complete processor context, all ACT registers and all RAM registers, are saved to a file of your choice. You can load this file later and the calculator code will proceed exactly from this point.

16.2 Load

When you have saved your code analyzing session you can load one of the files to proceed where you have stopped perhaps the day before.

17. Operator

There is even more! When you click the „Show Operator“ button, a new set of buttons will appear. The buttons, which appear on the right side are mainly reserved for programming the HPLP by PANAMATIK before delivery. They are used to program the 512kByte Flash Memory, which contains the ROM instruction codes of all calculators, key tables, texts and much more. Because there can arise unexpected results, if you use these buttons, they are disabled by default. Only by entering the Operator Passwort they can be activated. But some (not dangerous) buttons are always enabled.



„Get HP Type“

This reads and displays the actual calculator type in the message field. It can be used to check whether the connection is established correctly.

„Get Version“

Reads and displays the actual firmware version in the message field.

„Get Date Time“

Reads the actual date and time snapshot and displayes it in the message field.

„Enter Bootloader“

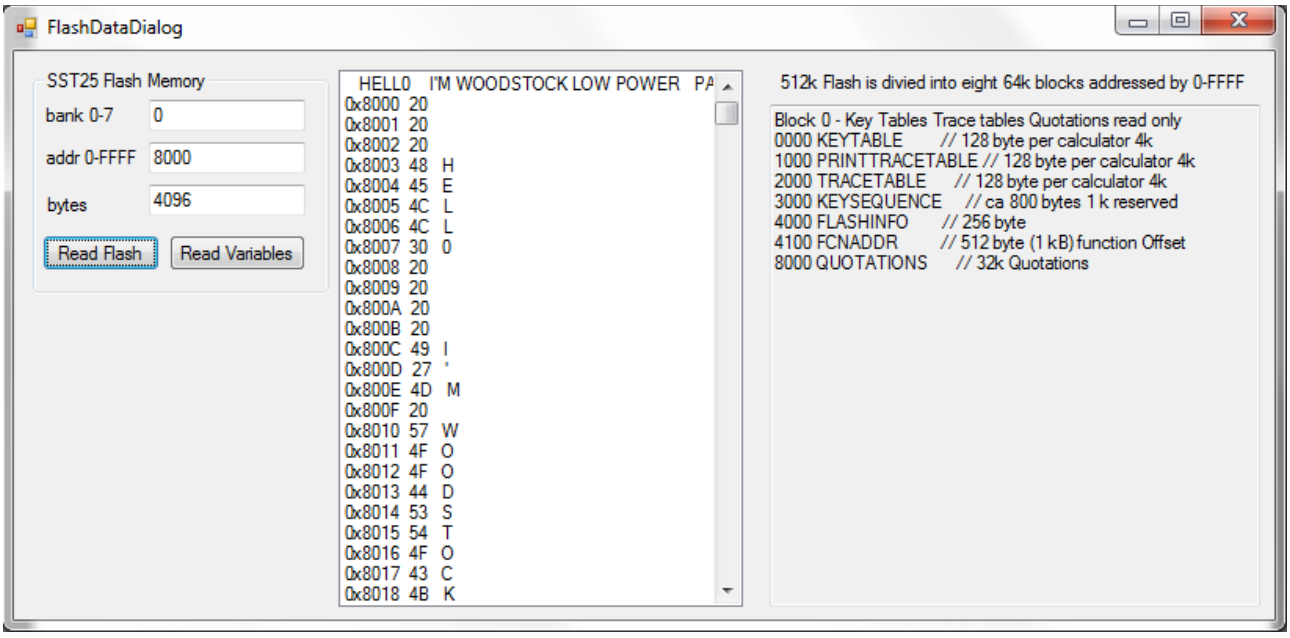
With this button you enter the bootloader. The normal communication with the LP circuit will not longer be possible. The display shows either the bootloader version or all 8s. If the newer bootloader is installed you can restart the LP application and leave the bootloader.

„Start application“

With this button you leave the bootloader and the LP circuit will start up. Only the newer bootloader version, which shows the version 1.12 in the display, is capable of jumping to the application by the „Start Application“ button. With the previous boot loader version the calculator must be switched off and on again.

18. Get Flash Data

A dialog appears when you press „Get Flash Data“.

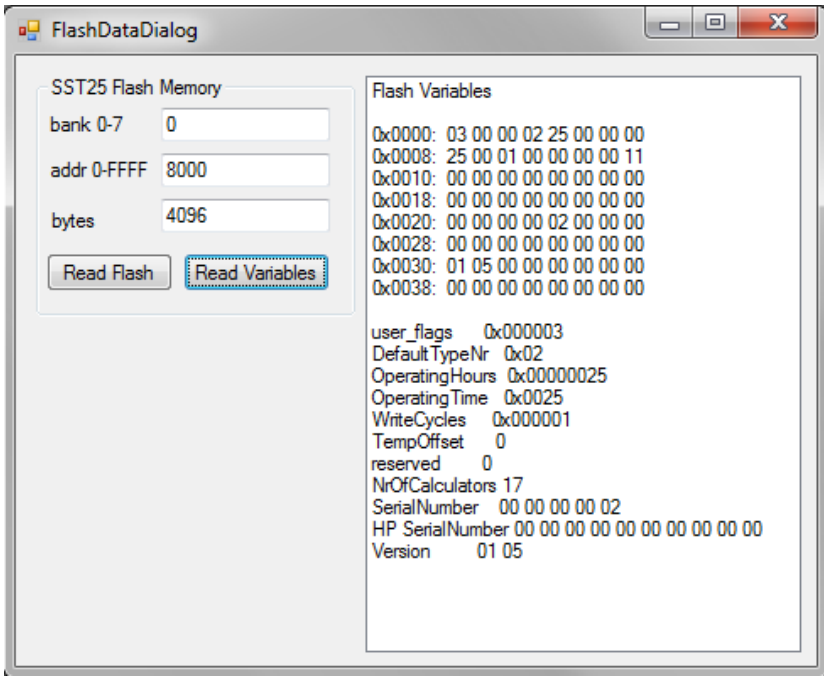


18.1 ReadFlash

With „Read Flash“ button you can read any portion of the 512k Flash memory. It will be displayed as HEX characters and every 64 bytes as a character string. You can only display the contents but not erase or write. The flash memory is divided into 8 banks of 64k. The adress within the bank can be set in the addr field before reading.

18.2 Read Variables

„Read Variables“ shows a specific portion of the flash memory which contains the so called flash variables.

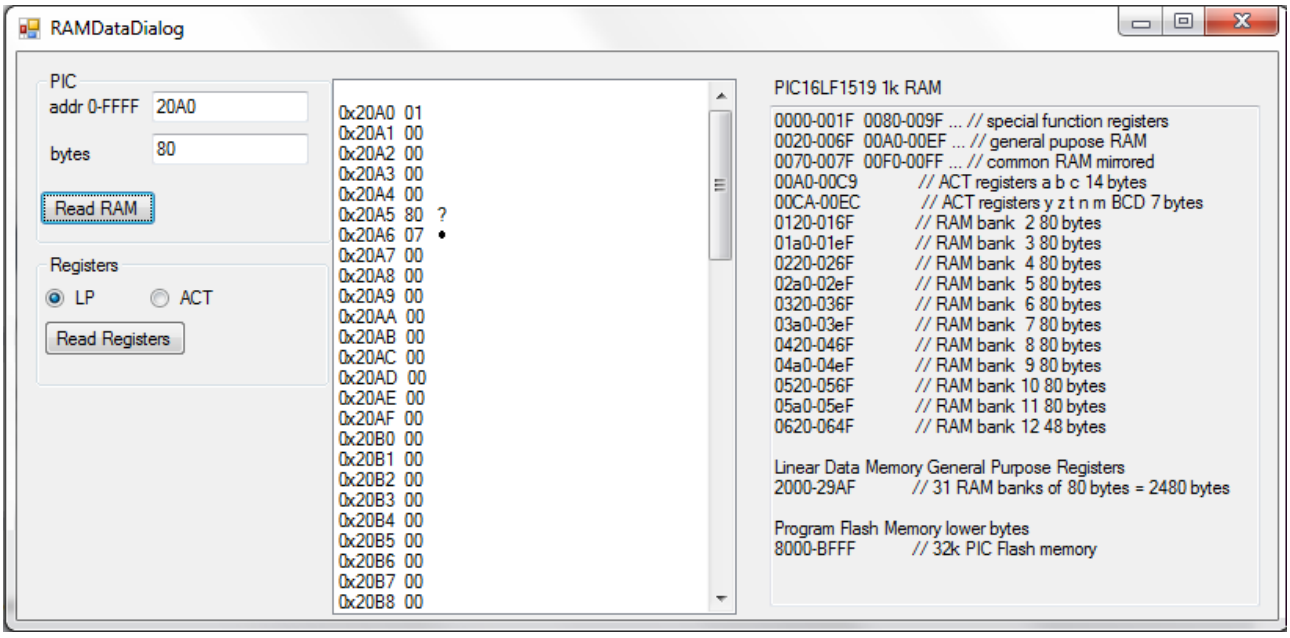


19. Get RAM Data

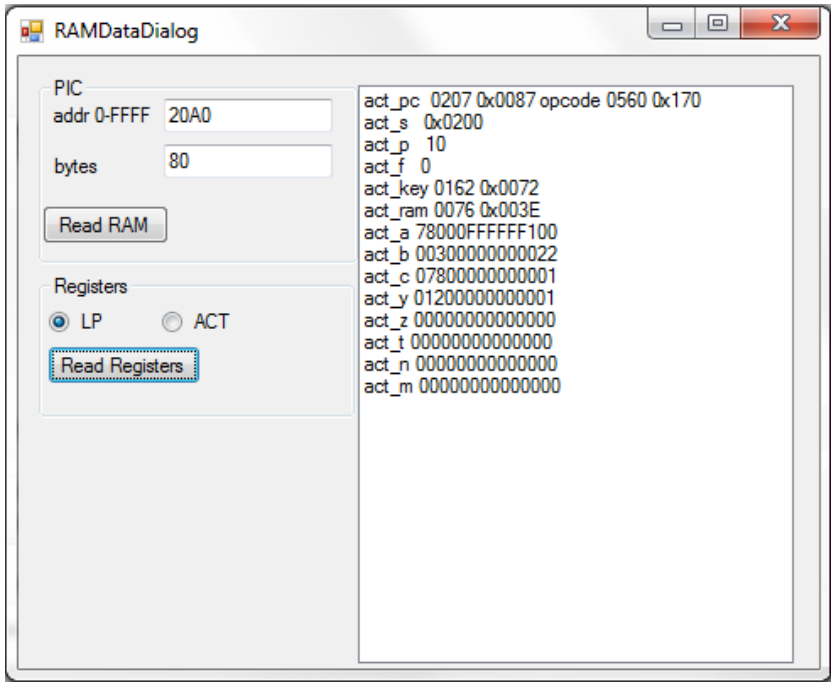
This button opens a dialog for reading RAM (Random Access Memory of the PIC processor).

19.1 Read RAM

You can enter any address within the allowed range 0-FFFF and with „Read RAM“ the contents of the RAM will be displayed. There is no special purpose for this, unless you want to analyze the PIC memory. In the image below you can see the begin of the „Continuous Memory“ of the current running calculator. The first 7 bytes shows register R0, which contains the number 78.00.



19.2 Read Registers



„Read Registers“ shows the ACT registers of the LP circuit, which should display the same values as in the main menu.

Appendix

HP-25 Program Steps Mnemonics

```
"GTO nn", "FIX n", "SCI n", "ENG n",

"STO n", "RCL n", "STO+n", "STO-n", "STO*n", "STO/n",

"->H.MS", "INT", "SQRT", "Y^X", "SIN", "COS", "TAN", "LN", "LOG", "->R",

"->H", "FRAC", "x^2", "ABS", "SIN-1", "COS-1", "TAN-1", "e^x", "10^x", "->P",

"0", "1", "2", "3", "4", "5", "6", "7", "8", "9",

"x<y?", "x>=y?", "x!=y?", "x=y?", "x<0?", "x>=0?", "x!=0?", "x=0?",

"LASTX", "PAUSE", "", "CL", "CLREG", "CLSTK", "xmean", "s", "E-",

"PI", "NOP", "", "DEG", "RAD", "GRD", "%", "1/x",

"-", "+", "*", "/", ".", "R/S","ENTER","CHS","EEX","CLX", "x<>y","ROLL","E+",
```

HP-29C Program Steps Mnemonics

```
"R/S", "RTN", "ENTER",  "CHS",  "EEX", "CLX", "CLREG", "CLE",

"0", "1", "2", "3", "4", "5", "6", "7", "8", "9", ".", "-", "+", "*", "/",

"INT", "FRAC", "ABS", "SQRT","x^2", "Y^X", "%", "1/x", "PI", "LastX",

"SIN", "COS", "TAN", SIN-1", "COS-1", "TAN-1",

"e^x", "LN", "10^x", "LOG",

"x<=y?", "x>y?", "x!=y?", "x=y?","x>0?", "x!=0?", "x=0?","x<0?",

"->H", "->H.MS", "->P", "->R",

"FIX", "SCI", "ENG",  "DEG", "RAD", "GRD",

"X<>Y", "ROLL", "E+", "E-", "xmean", "s", "PAUSE",

"DSZ", "ISZ",

"GSB n", "GTO n", "LBL n" "GSB(i)", "GTO(i)", "LBL(i)",

"RCL n", "STO n", “STO-n”, “STO+n”, “STO*n”, “STO/n”, “STO-.n”, “STO+.n”, “STO*.n”, “STO/.n”

"RCL(i)", "STO(i)", "STO-(i)", "STO+(i)", "STO*(i)", "STO/(i)",

 "PRX",  "PRSPC",  "PRSTK",  "PRE",  "PRREG",
```

HP-33C Program Steps Mnemonics

```
"GTO", „STO", "RCL" "RTN" , "GSB"

"0" , "1" , "2" , "3" , "4" , "5" , "6" , "7" , "8" , "9" , "." , "R/S" ,

"-" , "+" , "*" , "/" ,

"SQRT" , "LN" , "LOG" , "Y^X" , "->R" , "->RAD" , "->HMS" , "SIN" , "COS" , "TAN" ,

"LASTX" , "PAUSE" , "x<=y" , "x>y" , "x!=y" , "x=y" ,

"x^2" , "e^x" , "10^x" , "1/x" , "->P" , "->DEG" , "->H" , "SIN-1" , "COS-1" , "TAN-1" ,

"PI" , "%" , "x<0" , "x>0" , "x!=0" , "x=0" ,

"FIX" , "SCI" , "ENG", "GRD" , "L.R." , "E+" , "CHS" , "EEX" , "CLX" ,

"RAD" , "x" , "E-" , "ENTER" , "CL REG" , "CL STK" ,

 "DEG" , "NOP" , "s" , "INT" , "FRAC" , "ABS"
```

HP-34C Program Steps Mnemonics

```
"0" , "1" , "2" , "3" , "4" , "5" , "6" , "7" , "8" , "9" , "." , "R/S" ,

"SF 0", "SF 1", "SF 2", "SF 3","CF 0", "CF 1", "CF 2", "CF 3", "F?0", "F?1", "F?2", "F?3"

LBL", "LASTX" , "GRD" , "ISG", SOLVE", "SUM", "CLREG" , "CLR E" ,

"x!" , "e^x" , "LN", "RTN" ,  "1/x" , "10^x" , "LOG"

FIX", "SCI", "ENG" , "Y^X" , "x^2" , "SQRT" ,

DEG" , "RAD" , "PI" , "." , "y" , "R->P" , "P->R" ,

RCL E," , "ROLL UP" , "r" , "D->R" , "R->D" ,

RCL" "RCL 8" , "RCL 9" , "RCL(i)" , "RCL I" , "L.R." , "HMS->H" , "H->HMS" ,

RCL ." , "DSE" , "GSB I" , "D%" , "SIN-1" , "SIN" ,

STO" , "STO(i)" , "STO I" , "/x" , "COS-1" , "COS" ,

STO ." , "DSP I" , "GTO I" , "s" , "TAN-1" , "TAN" ,

"ENTER" , "%" , "x<0" , "x<=y" , "-" ,"CHS" , "INT" , "x>0" , "x>y" , "+" ,

"EEX" , "FRAC" , "x!=0" , "x!=y" , "*" ,"CLX" , "ABS" , "x=0" , "x=y" , "/" ,

"X<>(i)" , "ROLL" , "X<>I" , "X<>Y" ,"PAUSE" , "E-" , "E+" , "R/S"
```

HP-67 Program Steps Mnemonics

```
"R/S" , "1/x" , "x^2" , "SQRT" ,"E+" , "E-" , "Y^X" , "LN" , "e^x" ,"LOG" , "10^x", "RTN" ,

"SIN" , "COS" , "TAN" , "SIN-1" , "COS-1" , "TAN-1" ,

"0" , "1" , "2" , "3" , "4" , "5" , "6" , "7" , "8" , "9" , "." , "+" , "-" , "*" , "/" ,

"ENTER" , "CHS" , "EEX" , "CLX" ,

"N!" , "/x" , "s" , "%" , "%CH" , "ABS" , "INT" , "FRAC" , "RND" ,

"X<>Y" , "X<>I" , "ROLL" , "ROLL UP" , "ENG" , "FIX" , "SCI" ,

"R->P" , "P->R" , "D->R" , "R->D" , "H->H.MS" , "H.MS->H" , "H.MS+" ,

"STO (i)" , "RCL (i)" ,

"SPACE" , "PAUSE" , "-X-" , "STK" , "LASTX" , "W/DATA" , "MERGE" , "PI" ,

"DEG" , "RAD" , "GRD" , "P<>S" , "CLREG" , "REG" ,

"x!=y" , "x=y" , "x>y" , "x!=0" , "x=0" , "x>0" , "x<0" , "x<=y" ,

"F? 0-3" , "CF 0-3", "SF 0-3 ,

"ISZ I" , "ISZ (i)" , "DSZ I" , "DSZ (i)" ,

"DSP 0-9" , "DSP (i)" ,

"RCL 0-9" , "RCL A-E", "RCL I" ,

"STO 0-9" , "STO A-E" , "STO I" ,

"STO - 0-9" , "STO - (i)" ,

"STO + 0-9" , "STO + (i)" ,

"STO * 0-9" , "STO * (i)" ,

"STO / 0-9" , "STO / (i)" ,

"GSB 0-9" , "GSB A-E" , "GSB a-e" , "GSB (i)" ,

"GTO 0-9" , "GTO A-E" , "GTO a-e" , "GTO (i)" ,

"LBL 0-9" , "LBL A-E" , "LBL a-e" , "LBL (i)" ,
```

Files

The Conn Kit application uses some files, which must be located in the same directory than the .exe application.

Application file

The executable is named HP25LP.exe. Although the LP Conn Kit is not only for the HP-25, but a multicalculator application, this name was choosen because the HP-25 is the most common and my favourite calculator. There is no installation necessary. Just start the application from its directory.

Bitmap Files

Each calculator has its own .bmp image file, which is loaded when the calculator is selected: hp21.bmp hp22.bmp hp25.bmp etc. If the file is not present the application will show the HP-25 bitmap, although the buttons will react differently.

Disassembly files

These files with ending .dis contain the machine code for each calculator. They are essential to emulate the calculator and show and execute its machine code. You can edit these files to enter your comments, but it is not allowed to insert or delete lines. If you are very experienced and change the machine operation codes you can change the calculators behaviour. For adding your comments use the „Show Code“ window. It is save because you cannot unintentionally delete lines or change the code.

Preferences

This small file contains your last saved preferences. If it is not present default values are used.

Update files

For updating your HPLP circuit to the newest version you find an update file like HP25LP105.act.

Flash files

There is a file „HPLPflash105.bin“, which can be programmed to the 512 k flash memory. It only updates the fixed part of the memory, necessary to run the LP circuit, but does not affect your user data.

Backup files

These .wlp files are your personal backup files with user data, all programs all register sets. Constants and „Continuous Memory“ you previously have saved. The file extension is .wlp

(Woodstock LP) . There is a default Backup file ClearMemory.wlp, which clears all your data to factory settings.