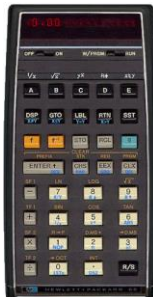


HP CALCULATOR REPLACEMENT CPU BOARDS

+ HP-35 50th Anniversary Poster Project



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NOTE: These replacement boards will not help repair a calculator if the card reader or any of the parts associated with the keyboard and display are faulty.

Disclaimer

The material contained within this project is supplied without representation or warranty of any kind. The author therefore assumes no responsibility and shall have no liability, consequential or otherwise, of any kind arising from the use of this project or any part thereof.

PIC18F45K40 and PIC18F66K40 Operating Systems - Source and Binary Code - Copyright A. Nixon 2021

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Caution

Some components on the circuit board may be damaged by static electricity. Always handle the circuit board by the edges.

Do not exceed 5V battery voltage.

Do not use a battery charger while the calculator is in use unless the charger voltage that feeds the calculator circuitry is $\leq 5V$. (97 standard charger is ok)

Operating the board from a battery charger with batteries removed may damage the circuit board components.

Observe correct battery polarity.

Features



HP-55



HP-65



HP-67

- A drop in replacement for the HP-65 and HP-67 CPU boards.
- Executes the original microcode
- Supports all card read write functions*
- Option to bypass the card write protection*
- Inbuilt memory supports storage for up to 810 programs. (100 for HP-55)
- Save and recall calculator state – HP-67 has Continuous Memory feature
- Can display messages when programs running*
- Bluetooth connectivity
- Upgradeable software
- HP-55 can fine tune timer
- PC support program

* N/A for HP-55

Installation

Pictures show the HP-67 but the procedures for HP-55 and HP-65 are similar,

The new CPU board installation is easy and only requires a Phillips head and a small flat bladed screw driver. A tool like a thin blade will also be required to remove two screw covers on the rear casing and to pry up the label. The label can also be removed with a hair dryer and the procedure can be found by searching the [HP museum forums](#).

Open the calculator battery compartment and remove the battery. Remove the two screw covers located on the top underside of the calculator and remove the screws.

Pry up the outer edge of the bottom rubber feet with the flat screw driver and remove the screws behind them.

There are two screws hidden underneath the back label. Use a method described above to expose the screws which can then be removed. The rear case can now be removed.



The card reader circuit board needs to be unplugged from the main circuit board. This can be achieved by placing the flat screw driver between the card board and the main board and gently levering it up. The lever points should be alternating at either side of the connector pins. Do not try to pull the board out with your fingers or it may suddenly give and damage the board or wiring.



To remove the main board, place the flat screw driver under the right hand lower edge of the board and over the raised edge of the case. Twist the screw driver slightly and the board will begin to rise up. Move the screw driver an inch to the left and twist again. Repeat the procedure towards the left side of the board. If by this stage it hasn't fully released, start the process again from the right side.





Once the original board is out, the new board can be placed in position. Make sure the connectors are lined up correctly on the lower edge and push down gently on the right hand bottom edge with a thumb nail or the flat edge of the screw driver. Repeat the process moving towards the left hand side.

Removing and replacing the board in this manner reduces any stress on the board and contacts.



The card reader connector can now be placed back into the main board connector holes. Make sure it is not pushed in too far as the connector pins are tapered and the tension between the connectors and the board holes will reduce and may make a poor connection which will affect the card reader operation.

Make sure the card reader circuit board is placed correctly. There is a small plastic moulding that fits in a hole to help locate the board into position. Avoid moving the card reader board too much or you risk breaking wire connections.



For non Continuous Memory models, before re-assembly make sure the Comms switch is in the left Bluetooth position. Replace the calculator rear cover.

See [CPU Connections](#) and [Setting up Bluetooth](#).

Make sure the calculator is turned off and insert a charged battery and replace the battery cover. Turn the calculator on. It should now work as a normal calculator.

Note: Due to the fact that upgrades can occur, you may consider leaving out the 2 screws underneath the back label.

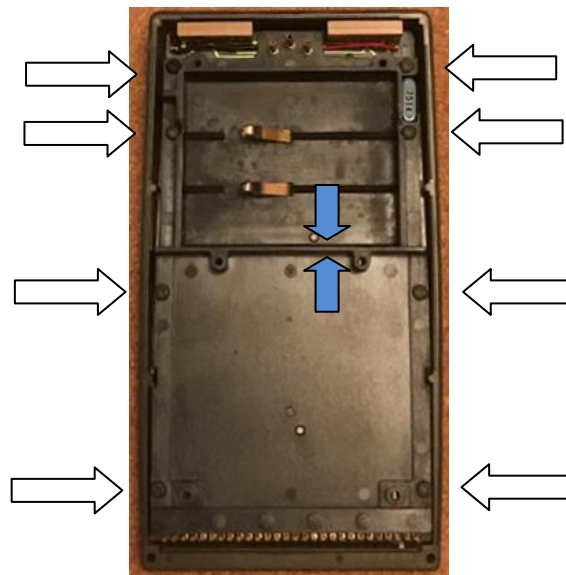
HP-55 Installation

The circuit board is quite thin and care must be taken not to bend it too much or components may break or dislodge. If the original crystal is to be used, just insert the circuit board and reassemble the calculator.

The HP-55 can be used with or without the original crystal with the new CPU board.

Note: If the original crystal does not work, then the CPU board can provide the required clock signal to run the anode driver.
The HP-55 board is supplied with the CPU oscillator driver turned on.
If you plan to keep using use the original crystal, then you should turn off the CPU oscillator driver with the PC companion program using – [Info -> Write].

The following steps will guide you through the process of removing the crystal.
After removing the original CPU board, remove the eight screws as shown. Grab the plastic support base at the point shown by the blue arrow and lift upwards. The keyboard will come up with the plastic support and may sag down as it is only secured by 2 wires at the top.



Keep the screws in a safe place.

Take care not to turn the keyboard top side up or the plastic keys will fall out along with the 2 switch contacts.

Flip the plastic support base up and over the 2 coil assemblies.

Try not to move it too much or the wires may break, or partially break.

The next step requires a small soldering iron and some solder so that the crystal can be removed.



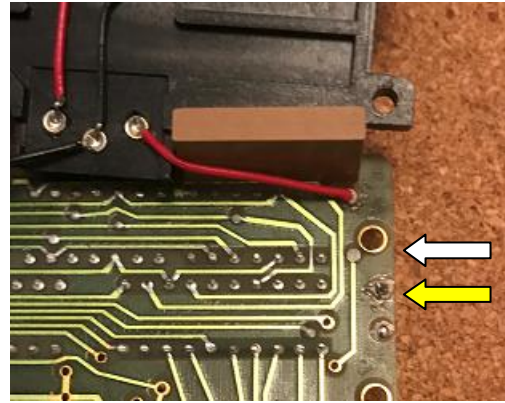
The two arrows indicate the crystal solder points.

From the other side of the board, pinch the crystal between your thumb and fore finger.

Place the heated soldering iron onto a crystal contact and as the solder melts, pull the crystal and it should pull away from the board slightly.

Repeat the procedure with the other contact.

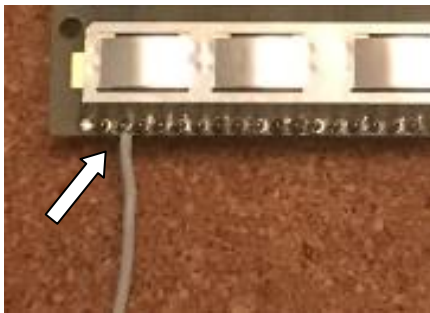
Important: Try not to overheat the crystal.



Continue doing this until the crystal finally comes away.

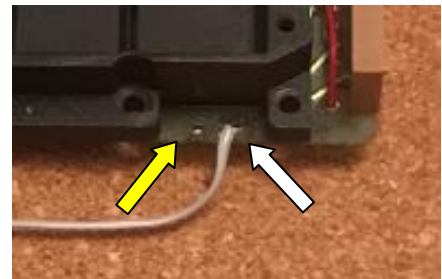
There will be a small piece of wire provided with the CPU upgrade that is pre-tinned at both ends.

Insert the old CPU board back onto the connecting pins at the bottom of the keyboard. Press it down just enough so it sits on the pins without coming loose. This will provide support for the connecting pin which is about to have its base soldered.



Solder the pre-tinned wire end to the third contact as shown in the image at left.

You may need to tin the contact with fresh solder before attaching the wire.



The other end can now be soldered to the now vacant crystal connector that is closest to the top of the board shown with the white arrow. Remove the CPU board.

Before reassembly, check that the red and black wires coming out of the charger socket are not squashed between the black plastic and the circuit board. Make sure the switch connectors are still where they are supposed to be.

Carefully reassemble the keyboard into the upper case half. Line up the screw holes with the case and drop the assembly down. It should fall into place. The board fits snugly and should not rock up and down when pressed if it is sitting properly. Insert the screws and do not over tighten. Route the wire so that it will not interfere with the case bottom.

You can now insert the CPU board and replace the back cover. You may consider leaving out the two screws that go under the back label to make future case removal easy.

CPU Connections

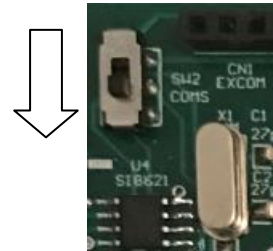
Note: Continuous Memory models have automatic switching.

To enable the selected connection mode a switch on the CPU board must be set to the correct position.

Bluetooth Mode (Normal operation)

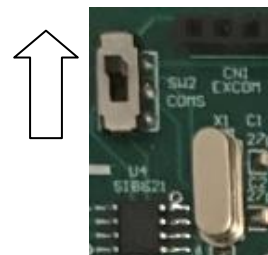
HP-55

Switch to left position.



Cable Mode (Re-flashing)

Switch to right position.



The switch should only be moved when [re-flashing](#) of the processor is required, and then can be restored afterwards.

NOTE: The switch has been removed for Continuous Memory CPU boards where this function has become automatic.

Setting Up Bluetooth

During the installation procedure, the communications switch was set to Bluetooth. See [CPU Connections](#).

An inbuilt Bluetooth Module is used for normal wireless communications between the calculator and a host PC that runs the CalCom.exe companion program.

The procedures for setting up Bluetooth for a particular PC may vary so it will be up to the user to follow individual requirements.

Turn on the calculator and hold the [f] key down to Enable Menu Mode. Press the [+] key until the [Connect Y N] item appears. Press the [D] key to enable the connection. If the calculator rear case is removed, then a flashing LED should be seen on the CPU board.

When the LED is flashing the module is hunting for a Bluetooth master and uses more power than normal, so it will be useful to establish a connection quickly to conserve battery power. Once a connection is established, the power requirements reduce considerably.

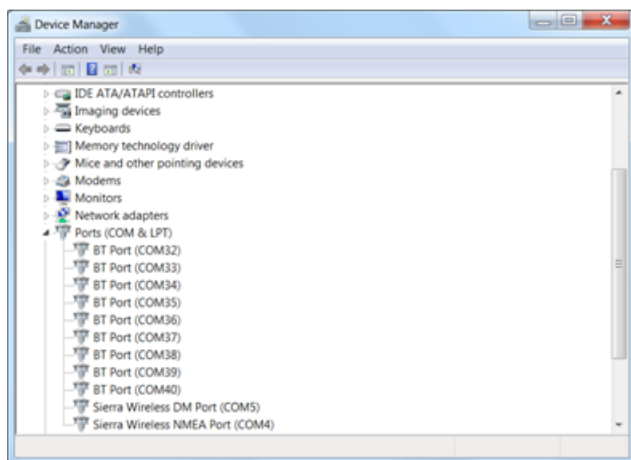
If your PC supports Bluetooth connectivity, then it will have its own set of procedures to enable Bluetooth and to find and pair to a Bluetooth device.

If you follow those procedures, you should find the calculator Bluetooth device named TEENIX. Allow connection to this device and the PC will set up the connection and assign a COM Port number.

The CalCom.exe program will need to know the COM Port that is created by the PC when the calculator Bluetooth device is paired.

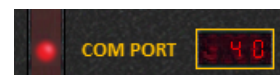
This number can be accessed from the Control Panel – Hardware and Sound – Device Manager – Ports (COM & LPT) – BT Port (COMx). X will be the Port number, which may have multiple numbers as shown in the image at right.

As many COM Port numbers can be assigned to Bluetooth, I noted the highest number first. (40 in this case)



Run CalCom.exe and you will get a connection error message if the operating COM Port number does not match the one assigned to the Bluetooth module.

Click the [COM PORT] label and enter the highest COM Port number that was noted in the above procedure. Press the PC [Enter] key. If a connection can be established, you will see a password window open. If you get an error message you will have to try another of the listed port numbers.



When prompted, the password for the calculator Bluetooth module is **0000**.

If a connection is established you will get a message similar to the following.

```
Calculator connect query... >OK  
  
Calculator Model          = HP-67  
Write Protect Override   = OFF  
PRGM/RUN Switch          = RUN  
Software Version         = 01
```

Once this procedure is set up, future connections should establish automatically when the CalCom.exe program starts as long as...

- Bluetooth is enabled on the PC
- The COM Port number has not changed
- The calculator is turned on
- The calculator Bluetooth is enabled

When the connection is established, the LED on the CPU board will be in a steady on state.

To give a normal indication that the calculator Bluetooth is turned on, the decimal point LED in the exponent tens digit on the calculator display will light.

If a connection cannot be established, make sure the Comms switch is set to the left side position for Bluetooth communications and check the status of the CPU board LED.

See – [CPU Connections](#).

Windows 11 Users

Windows 11 may not recognise the Bluetooth module. If not, the following details may help. The method confirmed as working.

Go to Bluetooth devices > Devices

There is an option called Bluetooth devices discovery set in default, change that to advanced.

Activate the Bluetooth module in the calculator, navigate to the Windows add a new Bluetooth device screen, the calculator should appear.

Menu Mode

The new calculator software has a menu system to let you save and recall programs and set operational options.

To gain access to the menu system, press and hold the f key. After about ¾ of a second, the menu will become active.



When the menu indicator is shown on the right side of the display, the item being shown has sub menus which can be accessed by pressing the [Enter] key.

In any menu level, other menu items can be selected by using the [+] and [-] keys



The **Connect** menu item does not have sub menus. However, it has two options, [**Y**] and [**N**] which can be selected by pressing the key directly beneath the option. In this case, the [D] key will select the **Y** option and the [E] key will select the **N** option.

You can exit menu mode at anytime by pressing the [R/S] key.

Pressing [CLx] will jump back to the root menu, or if entering data, will clear the data so you can start entering it again. It will also exit menu mode if in the root menu.

Calculator State

When you access the menu, the first item is [CALC StAtE].

Note: Not available for Continuous Memory boards

Selecting this menu item with the [ENTER] key brings up a sub menu to save or recall the calculator state data. Use the [+] or [-] key to cycle between these two menus.



Selecting this item will save the current calculator state to the external memory storage.



Selecting this item will recall the calculator state from external memory storage and the calculator will resume from when the state was last stored.

The idea for storing the calculator state is to save the data then turn off the calculator, although you can continue on and have that state saved for later use. For example if you are about to try and modify a complex program and mess up the code, you could recall the state that has the original program and start again.

When the calculator is switched on again, and the data is recalled, the calculator will resume exactly as it was when the data was saved.

The HP-55 PRGM/RUN/(timer) switch is tested for the same position on state recall. If there has been a change then the state data is invalid and a message is displayed. Just put the switch in the same position and recall again.



To select a menu item, press [ENTER].

You can exit menu mode at anytime by pressing the [R/S] key.

Pressing [CLx] will jump back to the root menu. It will also exit menu mode if in the root menu.

Menu - CARD

Sub Menus

- Store
- Read
- Prog Erase
- Bloc Erase
- Free
- Auto

Each of these items has a sub menu.

Menu → CARD → Store

Save the current program to memory storage.

Requires memory Block and Program entry, HP-55 requires Program only

Stored programs cannot be write protected

Menu → CARD → Read

Recall a program from memory storage,

Requires memory Block and Program entry, HP-55 requires Program only

A “Card Erased” message will appear if the program is blank.

If so, press any key to continue.

Menu → CARD → Prog Erase

Erase a single program

Requires memory Block and Program entry, HP-55 requires Program only

Menu → CARD → Bloc Erase (HP-65 HP-67)

Erase a block of programs

Requires memory Block entry

Menu → CARD → Free

Finds the next free program in a block, or the entire memory for HP-55.

Requires memory Block entry. HP-55 only needs [ENTER] key.

Menu → CARD → Auto (HP-65 HP-67)

Starts the card auto read/store feature

Requires memory Block and Program entry

A “Card Erased” message will appear if the program is blank.

Press any key to continue.

In all cases, pressing the [ENTER] key will activate the menu item.

NOTE: If there is a problem accessing the external memory an “Access Error” message will appear. Press any key to continue.

Program Access

Programs can be stored and recalled from internal storage memory.

Total storage:	HP-55	100 programs
	HP-65	810 in Blocks of 54
	HP-67 or HP-97 can be program or data	810 in Blocks of 54

Blocks are labelled 0 – 9, and then A – E. Programs are labelled 00 – 53.
For the HP-55, there are no blocks and programs are numbered 00 – 99.

Block and Program Entry

For menu items that require a block and program to be entered, a menu screen will appear as shown. Note: The HP-55 will show PG_ and only requires 00 – 99 to be entered.



The menu is expecting a Block number in the range 0 – 9, or A – E which is entered by the pressing the appropriate keys on the keyboard, then the program number 00 – 53.

Example: Saving a program to Block E, Program 23
Press keys, [E] [2] [3]



If a block only is required, just enter the block number.

Example: Finding the next free program in block 3
Press key [3]



Except for HP-55, you can scroll through program names in a selected block. Program Names mode is the default access method and the name of the program will be shown on the LED display. Not all ASCII characters can be displayed in LED format and those that cannot are displayed as an underscore. The following shows the available characters.

0 1 2 3 4 5 6 7 8 9 A C E F G H I J L N O P S U b c d f g h i j l n o p q r s t u y (space)

Keys:	+ and -	Scroll up/down through programs in current block
	x and div	Increment or decrement block in scroll mode
	Enter	Select program
	CLx	Jump to root menu
	R/S	Exit menu mode
	EEX	Resets to digit entry mode
	CHS	Resets to scroll mode

The HP-67 program name displays also show the type of card. If a [-] is showing in the exponent sign digit, the card is data, else it is program. The next two digits show card X of Y.

Examples:	[]11	Program Card 1 of 1	[-]12	Data Card 1 of 2
	[]22	Program Card 2 of 2	[-]11	Data Card 1 of 1

When in scroll mode you can also start entering a block and program number starting with the block.

Note: Normal card procedures apply. This means that to store a card, the PRGM/RUN switch should be in the PRGM position. To read a card, and for W/DATA the PRGM/RUN switch should be in the RUN position.

Load Save Cards

Load

PRGM/RUN set to RUN

To load a card from memory storage press and hold the [f] key to go into menu mode and the **CARD** menu item will be displayed. Press [ENTER] to select.

Use the [+] key to go to the **CARD -> Read** menu item. Press [ENTER]

Scroll to, or enter the Block and Program number and press [ENTER].

The program data will be made available to the HP microcode which thinks a real magnetic card is being read.

If the program is part of a two card program the HP microcode will display **Crd** as normal. To load the next card, follow the procedure above to go into menu mode and select the next Block and Program number.

Save

PRGM/RUN set to PRGM

or

W/DATA (**Crd** will be displayed)

PRGM/RUN set to RUN

To save a card to memory storage press and hold the [f] key to go into menu mode and the **CARD** menu item will be displayed. Press [ENTER] to select.

Use the [+] key to go to the **CARD -> Store** menu item. Press [ENTER]

Enter the Block and Program number and press [ENTER].

The HP microcode will now think a real magnetic card has been placed into the card reader and try to write the data. However, the new CPU code will intercept the data as it is being written and store it into the memory storage. If the card is part of a two card program the HP microcode will display **Crd** as normal.

To save the next card, follow the procedure above to go into menu mode and select the next Block and Program number.

If the memory storage chip fails to write, the HP microcode will receive an error flag and it will terminate the write process and its normal **Error** display will show.

Programs and data that are stored to memory storage will be assigned a generic program name of the form...

Program [Block] [Program]

Note: As the HP microcode is controlling the transfer of memory storage data, all card flags will be set as normally happens for magnetic card read/writes. An example of the flags is the current display mode – Fix 2 etc.

Note: HP-55 and HP-65 do not support two card programs or W/Data. See: [Quick Load](#)

Auto Card Mode - HP-67 and HP-97 only

In the normal HP-67, you can have a program running and “park” a magnetic card in the reader slot.

See page 292 of HP-67 operator handbook.

If the program encounters a PAUSE instruction, the program will pause and the card that is “parked” will be read in to the calculator memory. If the program encounters a W/DATA instruction, the program will pause and the card that is “parked” will be used to store data from the calculator memory.

The new CPU board can also read or store the program to and from the external memory storage from a “parked” card.

The **Card – Auto** menu item selects the required function and is active only while a program is running.

Card → Auto → Auto card

When this item is selected, a program will be loaded from memory storage when the PAUSE instruction is encountered.

Card → Auto → Auto data

When this item is selected, data from HP calculator memory will be transferred to memory storage when the W/DATA instruction is encountered.

Card → Auto → Off

Cancels the card auto option.

Press [ENTER] to select the option, [CLx] to jump to the root menu, or [R/S] to exit menu mode.

In both cases, after [ENTER] you need to specify a memory storage location as described [here](#). Once the Auto option is enabled, the Exponent Units Digit decimal point will light.

NOTE: The Auto Card/Data option will only appear on the menus if a program is running.

If a magnetic card is placed in the calculator slot, the Auto option will cancel.

If the program stops running the Auto option will execute if still active.

Erasing Programs

The **Card -> Prog Erase** menu item erases a single program.

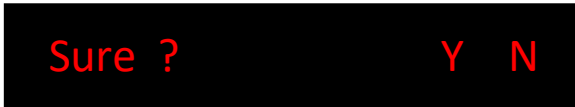
When this item is selected, a sub menu opens to [enter](#) a Block and Program number, or just the Program number for HP-55.

The **Card -> Bloc Erase** menu item erases all programs in a block.

When this item is selected, a sub menu opens to [enter](#) a Block number.

Note: Bloc Erase is not available for the HP-55. You can only erase a single program from memory storage.

When a block erase is selected, a “**Sure ? Y N**” message is displayed to verify the block is to be erased. Press [D] key to proceed, or [E] key to cancel.



Sure ? Y N

Menu - OPTIONS

Sub Menus

Prg Oride	HP-65 HP-67
Calc Id	
Notes	HP-65 HP-67
Continuous?	Continous Memory Models
Each of these items has a sub menu.	

Menu → OPTIONS → Prg Oride

Select this option to enable/disable the card write protection override.

Oride On
[ENTER] selects this option to enable override

Oride Off
[ENTER] selects this option to disable override

When write protect override is enabled, the card reader will ignore any clipped corners on cards and can overwrite whatever program or data is stored on them. This option is useful to re-write damaged original HP cards and restore those programs without having to modify the magnetic card.

Menu → OPTIONS → Calc Id

Select this option to enable/disable the calculator model display.

Calc Id On
[ENTER] selects this option to enable Calc Id

Calc Id Off
[ENTER] selects this option to disable Calc Id

When the Calc Id is enabled, the calculator will display the model number briefly when turned on.

Menu → OPTIONS → Notes

Select this option to enable/disable the notes feature.

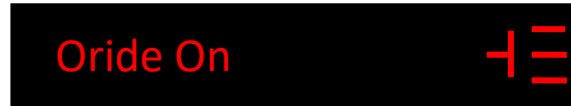
Notes On
[ENTER] selects this option to enable notes mode

Notes Off
[ENTER] selects this option to disable notes mode

The Notes option can be disabled so that the calculator can operate as a normal HP-67.
See – [Program Notes](#)

[R/S] exits menu mode
[CLx] jumps to root menu
[+ -] cycles menu items

The backwards “ \leftarrow ” character shown on a menu indicates the active option.



Menu → OPTIONS → Continuous

Select this option to set Continuous Memory operation

Contin On

[ENTER] selects this option to enable Continuous Memory
Continuous memory will be restored if it exists, else it will be in a reset state.

Contin Off

[ENTER] selects this option to disable Continuous Memory
The continuous memory will be available when re-enabled.

Contin Init

[ENTER] initialises Continuous Memory to a zero state.

Continuous Memory keeps the HP-67 memory in a non volatile state even when the power is removed. All HP-67 registers operate in the manner when it is enabled. If this feature is disabled, then the calculator will operate as a normal HP-67.

In addition to maintaining memory, the C register, LastX, the DEG RAD GRD setting, the current program pointer and the Default Key state are also preserved.

When Continuous Memory is initialized, the calculator memory will be reset to a zero state, the DEG, RAD, GRD and Default Key functions are all reset to default and the calculator is reset as though power was turned off and then back on.

Menu → OPTIONS → Debounce

Select this option to set the keyboard debounce delay.

These calculators have been around for some years now and the keyboard can start to operate as though keys are pressed multiple times instead of just once. The Debounce HI option may help to eliminate this problem by extending the time the software uses to detect a valid key press.

Debounce LO

[ENTER] selects this option to enable normal debounce delay

Debounce HI

[ENTER] selects this option to enable long debounce delay

Menu → OPTIONS → Turbo (HP-67 only)

Select this option to select normal or fast code execution speed.

The original HP-67 microcode operated at about 300uS per instruction. At this speed, calculating the SIN of a number could take about 1 second. When Turbo mode is selected, the CPU board processor will execute the instructions as fast as it can. Calculating SIN in this mode is calculated before the finger comes off the SIN key.

Turbo OFF

[ENTER] selects this option to enable normal code speed.

Turbo ON

[ENTER] selects this option to enable fast code speed.

PC Program

The companion PC program is used to transfer programs to and from the calculator and to re-flash the CPU board processor firmware.

The program is part of the install zip file and is called `CalCom.exe`.

When the program starts, it will try to communicate with the calculator and if connection is successful a screen message will appear listing the operating conditions.

If an error occurs, a message will appear suggesting some options to get it going.

There are two methods of connection available, Bluetooth and Cable and must be setup on the CPU board to function. In normal operation, Bluetooth is used.

See [CPU Connections](#).

To establish normal connection to the `CalCom.exe` program, turn on the calculator and hold the [f] key down to enable Menu Mode. Click the [+] key until the [Connect Y N] item appears. Press the [D] key under the Y symbol to enable the connection. The decimal point LED in the exponent tens digit on the calculator display will light indicating that Bluetooth is turned on.

Start the `CalCom` program. If a connection is successful, you should see a message similar to the following.

```
Calculator connect query... >OK  
  
Calculator Model      = HP-67  
Write Protect Override = OFF  
PRGM/RUN Switch      = RUN  
Software Version      = 01
```

If not, check the Bluetooth [setup](#) procedures.

The main screen is divided into two sections which are the operating functions and a feedback text panel. The operations are selected by clicking on an orange function label. Light orange labels are selected and are also highlighted by a red indicator. The darker orange labels are available for use but unselected. Greyed items are unavailable

When a function is highlighted, green indicators appear next to buttons which can then be used for that function.

Unselected

Selected

Not Available

Can be used

Can be used

Cannot be used



Main Functions

Update Driver	Upgrades the CPU firmware	Write
Settings	Reads the current calculator user settings Writes new settings to the calculator See - HP-55 Oscillator See also Writing EEPROM Mode	Read/Write
Program	Reads a program or RAW card data Writes a program or changes a card name Erases a program	Read/Write/Erase
Directory	Reads the program names in the current block Erases all programs in the current block	Read/Erase
Card Test	Continually reads the status of the switches for a magnetic card reader diagnostic Tests the card drive motor	Read Write
COM Port	Enables the selected COM Port	Write

Buttons

WRITE	Writes data to the CPU board
READ	Reads data from the CPU board
ERASE	Erases data from the CPU board
CANCEL	Cancels a running operation including re-flash and card test
CLEAR	Clears the text in the feedback panel
BT OFF	Terminates CalCom.exe See – Bluetooth Cancel
Notes	See – Program Notes
Dump	See – Memory Dump

Transferring Programs

Programs are stored in the CPU board in blocks. There are 15 blocks available and each block can store up to 54 programs. The blocks are numbered 0 – 9 and A – E. The programs are numbered 00 – 53. The HP-55 has programs 00 – 99 only, while the Spice models have blocks 0 – 9 and programs 0 to 29 available.

To transfer a program, the block and program numbers must be specified.

To do this, click on the [Program] function. The block/program entry box will highlight. Enter the block number followed by the 2 digit program number and then press the PC [Enter] key.

To read a card from a storage location, press [READ]. The data will be read from the CPU board memory and then three options will be displayed.

List	The program will be listed in the feedback window
Save to PC	The program can be save to a PC storage device
Clipboard as text	The program will be transferred to the PC clipboard

To write a program from the PC storage, press [WRITE]. A dialog will open so that a program file can be opened. After selecting a file, it will be verified and transferred to the selected storage location.

To erase a program from the selected storage location press [ERASE]. After a confirmation message, the program will be erased.

Directories

Directory functions require a block number to be entered. Only the block number will be highlighted in the block/program entry box.

To read a directory, press the [READ] button. All the programs from that block will be listed in the feedback window.

To erase a directory, press the [ERASE] button.

Bluetooth Cancellation

If the Bluetooth module remains on when the `CalCom.exe` program terminates the paired connection will be broken and the module will start using more power than normal while it tries to find another host. This may affect battery life.

Therefore, when the `CalCom.exe` program terminates it will command the CPU board to turn off the Bluetooth module to save battery power.

If you break the Bluetooth connection by turning it off from the calculator menu or by turning the calculator power -off and then try to close the `CalCom.exe` program the PC will hang for a period of time. This will also occur if the cable communication mode is operating if the FTDI module is disconnected.

To avoid this

- The CPU board should be powered up with either Bluetooth enabled or the cable FTDI connection established with the USB port before starting `CalCom.exe`.
- `CalCom.exe` should be terminated before turning off Bluetooth or removing the CPU board power or removing the FTDI board from the USB port.

Note that `Calcom.exe` will automatically try to terminate Bluetooth when it closes.

See – [FTDI Notes](#).

Program Notes

It may be handy to have the calculator display a note when a certain event happens during program execution. This function allows that to happen and up to 100 messages can be stored for use and is available for the HP-65 and HP-67 CPU boards. Notes can have up to 11 characters displayed (20 for HP-97 printing) and only these listed characters can be used.

To open the notes editor, click the Notes button. This button also allows you to transfer the notes stored in the calculator to the PC in case the local PC copy was corrupted or lost.

0	E	c	r
1	F	d	s
2	G	f	t
3	H	g	u
4	I	h	y
5	J	i	?
6	L	j	—
7	O	l	—
8	P	n	[spc]
9	S	o	
A	U	p	
C	b	q	

Enter a note by typing any of the allowed characters into the list. When completed, press OK. You will be notified if any errors occur. To enable any of these notes while a program is running you need to include the following keys in your program.

A single digit number may be used to specify the note numbers 0 – 9.

A 2 digit number is required to specify the note numbers 10 – 99. The note number is accessed from the X Register in the calculator during program execution.

Nibble [11] holds the 10's value and Nibble [12] holds the units value. Any number can be in the X register, so a blank note will be displayed for note number values outside the useable range. The note number needs to be entered units first and tens second. This is due to the way the X register is normalised in the calculator.

NOTE: For HP-67 version (20) and above, and HP-65 version (11) and above.

The notes value can be entered as you would expect. Example, enter [1] [h][A] for note #1, [2][3][h][A] for note #23. This will make indexed recalls of notes easier. If the number is register C is outside the range ABS(0 – 99), even after auto incrementing,, register C resets to zero.

A normally unused key combination is used to initiate the note. This is **[h] [A]** (HP-65 **[g] [A]**). This key combination will be shown on the display as **[35 11]**. During program execution, when the notes program token is encountered, the program will stop as if **R/S** was pressed and the selected note will be displayed. To continue running the program press **R/S**.

Another key combination is available. This is **[h] [B]**, (HP-65 **[g] [B]**), **[35 12]**. This function displays the note during a PAUSE sequence lasting for about 1 second, then the program will continue.

Early version examples:

You would like note number 29 to be displayed and then stop the program.

Press	9	Display	001	09
	2		002	02
	h A (HP-65 g A)		003	35 11

Later version examples:

You would like note number 07 to be displayed briefly and then the program continues.

Press	7	Display	001	07
	0		002	00
	h B (HP-65 g B)		003	35 12

Later version examples:

You wish note number 29 to be displayed and the program will stop.

Press	2	Display	001	02
	9		002	09
	h A (HP-65 g A)		003	35 11

You wish note number 07 to be displayed briefly and then the program continues.

Press	7	Display	001	07
	h B (HP-65 g B)		002	35 12

This feature can be enabled or disabled by clicking on the appropriate note menu item.

Notes: The note address is pushed onto the stack so the T register contents will be lost.
Note displays cannot be accessed from the keyboard in RUN mode.

Each time one of these functions executes, the C register will be incremented by 1. This can help with concatenating notes to form a message.

Notes Editor

The Notes Editor allows you to edit the notes that can be stored in the calculator CPU board memory chip.

A list of available characters for a note is shown on the right hand of the screen.

To enter a note, just type it into the list on the screen left. Each note must occupy a single line only.

Although more than 100 notes can be entered, only the first 100 will be used for storage in the calculator.

Buttons

Clear	Clears all notes
Initialize	To minimize the time it takes to upload notes, only changes are uploaded to calculator storage. If you suspect that the changes have become out of sync with the calculator, then pressing this button will erase the comparison table. All notes will then be transferred on the next upload.
OK	Tests the messages for errors, saves the note data to the PC hard disc and closes the window.
Cancel	Closes the window without saving the note data.
Upload on exit	This item, if checked, will signal the programmer window to upload the notes to the calculator storage when the notes window closes.

Note: The notes data file is shared between this program and the MultiCalc Emulator program if both of these programs share the same directory.

Memory Dump

This button will transfer the calculator memory into the CCE33 emulator.

For this to work...

- The calculator must be communicating with the CalCom software.
- The CCE33 emulator application must be running.
- The CCE33 emulator must have the same calculator model selected.
- The CCE33 emulator must be in [Step Mode].

HP-55 – Memory Transfer

30 Memory Registers

HP-65 – Memory Transfer

10 Memory registers
100 step Program Memory

HP-67 – Memory Transfer

64 Memory registers

Motor Test

This test is available for the HP-67 and HP-97.

To test the card motor, select **Test** from the CalCom options and click **Write**.

If the motor is functional, it will turn on for a second and then turn off.

RAW Card Data

When you read a card, the actual data, as well as being transferred to the HP memory, is also stored in a temporary buffer. This buffer contains the raw data as retrieved from the magnetic card, or from the internal memory storage.

When you have [Program] selected and press [Read], a dialog will appear asking if you want to read a stored program, or the raw card data from the previous read.

If you select the [Raw] option, the raw data buffer will be transferred to the PC and the information formatted to represent what was on the card including the Status and checksum values.

This can be handy if you experience card read errors and with this option you can see what data was actually read from the card and compare it to the program you expect it to be.

A magnetic card, or an internal program must have been read to fill the raw buffer. The buffer will hold the information until the next card read.

Re-Flashing the CPU Board

Updated CPU HEX files will be available on the [Teenix](#) web site from time to time and should be downloaded into the installation directory where the CalCom.exe program is located.

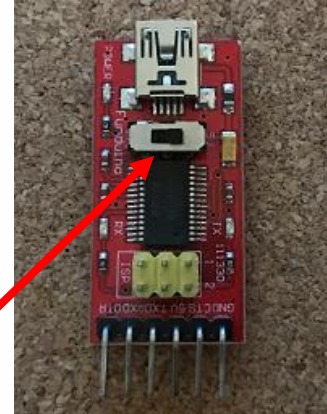
During re-flashing, the calculator PCB communicates with the PC calculator program via a commonly available FTDI USB Breakout Board. This item needs to be purchased separately, but they are available quite cheaply from the web and should come with a USB cable. If not the cables are also widely available.

The reason cable communications are used is because the Bluetooth transfers are not 100% reliable. If the connection is broken during the process, the reprogramming will not complete and the processor may cease to function. See [Emergency Boot](#).

Important:

Before use, set the FTDI slide switch to the 5V position.

The CPU board must be removed from the calculator during the re-flashing process.

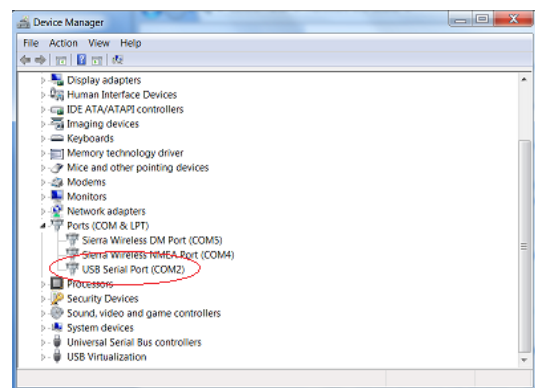


If the FTDI board is used for the first time, a driver may need to be installed and its COM Port assignment must be known.

Connect the USB cable to the FTDI board and connect the other end to a free PC USB port. The module may self install the driver, but if not you will have to download a driver from the FTDI web site. See – <http://www.ftdichip.com/Drivers/D2XX.htm>

The PC will assign a COM Port number to this device and you need to know this number to configure the CalCom.exe program.

This number can be accessed from the Control Panel – Hardware and Sound – Device Manager – Ports (COM & LPT) – USB Serial Port (COMx). X will be the Port number, which is **2** in the image at right. After noting the COM Port number, the Device manager windows can be closed.

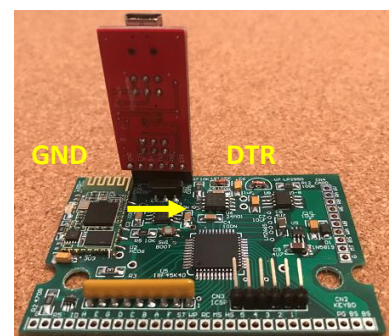


Unplug the USB cable from the PC.

Verify the marked pin connections on FTDI board before use or damage may occur to both boards.

GND CTS 5V TXD RXD DTR

Move the CPU board Comms switch into the right side position for [cable](#) communications. (For the HP-55, the switch is towards the top. This is automatic for Continuous Memory models.

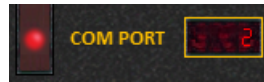


Insert the FTDI board into the socket on the CPU board as shown. This is a common position for all 3 CPU boards.

Insert the USB plug back into the PC USB socket. This will provide power to the CPU board.

Run the `CalCom.exe` program.

You will get a connection error message if the operating COM Port number does not match the one assigned to the FTDI board.



Click the [COM PORT] label and enter the COM Port number that was noted in the above procedure. Press the PC [Enter] key. If connection is established you will get a message similar to the following. If not, verify the COM Port number and change if necessary and check the USB and FTDI connections.

```
Calculator connect query... >OK  
  
Calculator Model      = HP-67  
Write Protect Override = OFF  
PRGM/RUN Switch      = RUN  
Software Version      = 01
```

To start the re-flash process, click on the [UPDATE DRIVER] option and click [WRITE].

The current upgrade HEX file for the CPU board will be loaded and verified. If all is well, the upgrade process will begin.

Important: Do not disconnect the CPU board during the re-flash process or the processor may stop working properly.

On completion, close `CalCom.exe` and unplug the USB cable from the PC.

Unplug the FTDI board from the CPU board.

Make sure the [Comms](#) switch is in the Bluetooth position and then fit the board back into the calculator.

If the re-flashing procedure fails, see [Emergency Boot](#).

Caution: The components used in this project may be damaged by static electricity. Handle the PCB only by the edges.



Do not connect the FTDI and PIC programmer at the same time.

If you want to re-flash the CPU with the same or earlier version (not recommended), then you can hold down the PC keyboard [Shift] key when you click the [WRITE] button. You can then select the `*.hex` file to program the CPU board with.

Note: Failure to program the correct HEX file may result in damage to the CPU board or calculator components.

CPU Board Emergency Boot

Important: The CPU board must be removed from the calculator before holding this button down when power is applied to the board. Improper display LED operation may result.

Note: Not available on some newer boards.

It is possible that during the re-flash process an error occurs and the software no longer functions. Normally a PIC programmer will be required to overcome this issue, but as a last resort, the software may be able to start in "Boot Mode" and another re-flashing process might be possible.

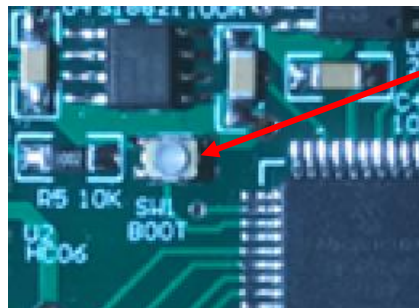
Make sure the CPU board is removed from the calculator and `CalCom.exe` is not running. Plug the [FTDI](#) board in to the socket on the CPU board and connect the USB cable.

Do not plug the other end of the cable into the PC USB port yet.

Press and hold down the small BOOT switch located just to the left of the microprocessor chip.

Apply power by inserting the USB plug into the PC socket.

Release the button.



Run `CalCom.exe`.

Hopefully a message like this appears. If not press the [INFO] button. If so, follow the normal re-flash procedure. Repeat the procedure if connection cannot be established. If this fails then unfortunately a [PIC programmer](#) will be required to program the chip again.

```
Calculator connect query... >OK

*****
*** Connected to bootloader program only ***
*****

Calculator Model      = HP-67
Write Protect Override = OFF
PRGM/RUN Switch      = RUN
Software Version      = 01
```

When the emergency boot loader program is active, you can only re-flash the processor.

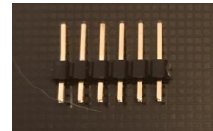
Once the processor has been re-flashed successfully, the CPU board will resume normal operation. Close CalCom, then unplug the USB cable and FTDI module. Refit the CPU board to calculator.

Re-Programming the PIC Processor.

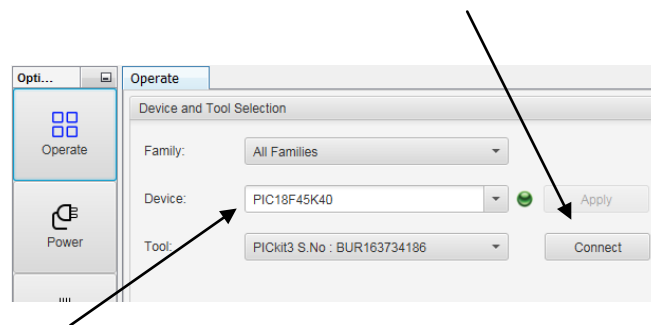
If the [re-flash](#) procedure failed and the [emergency boot](#) procedure also failed, then the PIC processor will need to be reprogrammed by a PIC programmer. The CPU board has been designed to accept a PICKit3 programmer and do ICSP programming.

Important: The CPU board must be removed from the calculator during this process.
Do not connect the FTDI board and PIC programmer at the same time.

You will need a copy of MPLAB IPE to control the PICKit3 and this is available as a free download from the [Microchip](#) web site. If the CPU board does not have a 6 pin male connector fitted, a 6 way IDC male connector is required to connect the PICKit3 to the CPU board. The pin spacing for this connector is 0.1". The long end should be inserted into the PICKit3.

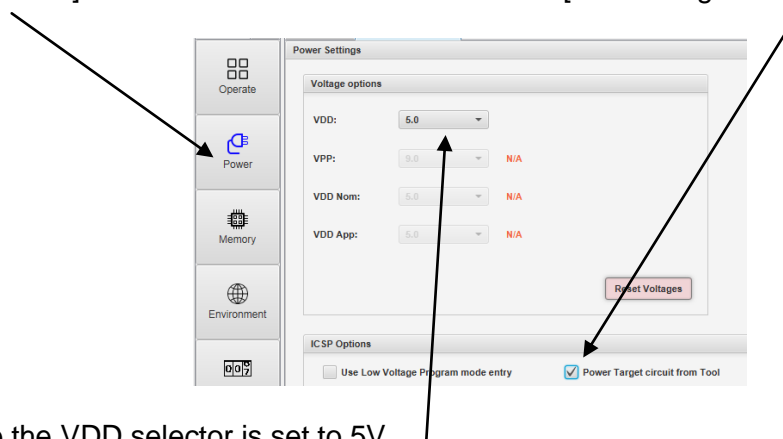


Connect the PICKit3 to a spare USB Port. The [Connect] button should enable once the connection is made.



Set the MPLAB IPE Device to the PIC18F45K40 using the drop down list.
For the Poster project, use the PIC18F66K40 device.

The PICKit3 needs to be able to supply operating power to the CPU board. In MPLAB IPE, click the [Power] button and check the item marked – [Power target circuit from tool]



Make sure the VDD selector is set to 5V.

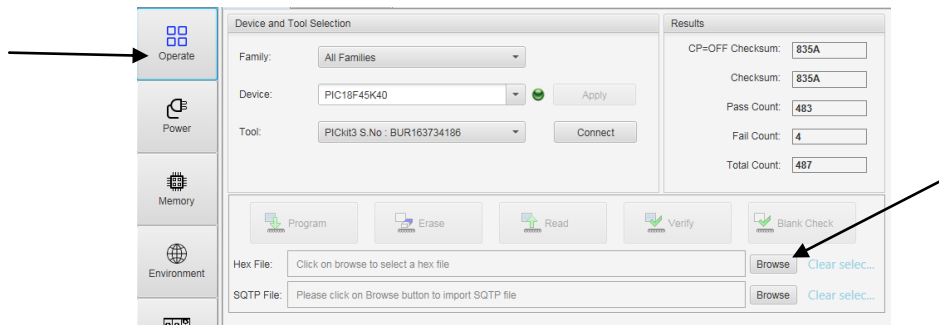
Click the Operate button to get back to the main screen:

Important: Make sure you have the latest CalCom and PIC firmware downloaded.

Click the [Browse] button to load the HEX file from the CalCom.exe install directory.

Eg: HPF6702.hex or poster.hex for the Poster.

Make sure the file type matches the calculator – Eg 67 for the HP-67 CPU board.
Load the file with the highest version number – Eg 02.



The CPU board Comms switch can be in either position. This is automatic for Continuous Memory models. Plug the PICKit3 into the connector as shown in the image.

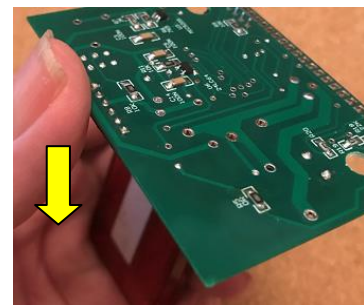
On CPU boards without a male connector, the PICKit3 can be plugged into the holes on the circuit board using the 6 pin IDC connector but the board will have to be held by hand with a **light** downward thumb pressure on the PCB as shown so that the contact pins stay firm against the PCB hole edges. It will program ok using this method. Try to handle the board only by its edges to avoid static damage.



HP-55 HP-65



HP-67



No Socket

Click [Connect]

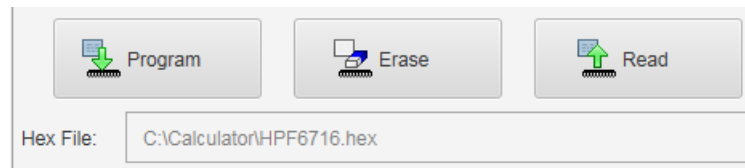
Ignore the voltage message that pops up.

You should get an output similar to this if the connection is successful.

```
Output - IPE
.....
Connecting to MPLAB PICKIT 3...

Currently loaded firmware on PICKIT 3
Firmware Suite Version.....01.54.00
Firmware type.....Enhanced Midrange
Programmer to target power is enabled - VDD = 5.000000 volts.
Target device PIC18F45K40 found.
Device ID Revision = a044
```

Press the [Program] button to start programming the PIC.



Hold the board steady during the programming process. It should only take about 20 seconds or so.

When programming is complete, unplug the PICkit3 from the CPU board then close MPLAB IPE and unplug the USB cable from the PC.

Make sure the [Comms](#) switch is in the Bluetooth position and then fit the board back into the calculator.

PIC Programming for the HP-67C Model CPU board.

Due to the semiconductor shortage, 24M01 memory chips normally used were not available and 24AA memory chips were used instead. These require different PIC code to operate.

The 24AA chip (if used) will be marked with a silver dot on the top of the plastic casing.

When you re-program the PIC with the PICkit3, the default 24M01 memory chip is selected.

If your HP-67C board has the 24AA chip, then this setting needs to be changed. If this setting is not changed, the internal memory card operations will not work properly.

To change the setting, connect the board, either via an FTDI module to the USB port, or via Bluetooth if the module has been placed back into the calculator.

Start `CalCom.exe` and verify that a connection has been made.

Make sure [INFO] is selected and click [WRITE]

You will be prompted to write the new `Info` or change the `EEPROM Mode`, choose the latter and OK.

Select the 24AA memory chip when prompted and click ok.

If you make a mistake and accidentally choose the 24AA when the board has a 24M01, then you can use the same procedure to change it back to the 24M01.

Notes On HP-65

The original HP-65 does not seem to address all error conditions when a card is read or written. For example, if the RUN/PRGM switch is changed while the card reader is active an error occurs but may also freeze the calculator.

To help avoid these errors, the replacement HP-65 CPU board will not access the card reader under the following conditions.

- If there is an error condition (ie. Display flashing)
- If the card is stalled in the reader and will not clear
- If the calculator is running a program
- If a key is held down while inserting a card

The keyboard and the RUN/PRGM switch are not tested when the card reader is active.

Notes on HP-55

The HP-55 CPU board can supply the clock signal to the anode driver if the original crystal is not working. The oscillator driver can be enabled or disabled when writing data from the Info Button. See – [HP-55 Installation](#).

Important:

If the calculator requires the external oscillator, do not turn it off or the calculator will cease to function. If the oscillator was accidentally turned off and the display appears to be wrong and very bright, immediately turn off the calculator.

You will need a FTDI breakout board to reprogram the oscillator on/off status.

The CPU board needs to be removed and the FTDI board plugged in and has been setup properly to work.

Connect the FTDI board to a spare USB socket using a USB cable.

See [PIC Re-Flash](#)

Start `CalCom.exe`

The board should be recognised. Select the [Info] item and use the [Write] button to set the oscillator to external mode.

Close `CalCom.exe`

Disconnect the FTDI board and reassemble the calculator.

Oscillator Fine Tune

The PIC driven HP-55 oscillator can be fine tuned if the timer is running fast or slow.

To tune the timer, make sure the Info item is selected from the `CalCom` screen and click [Write]. Select [Timer Calibration] and click [Ok].

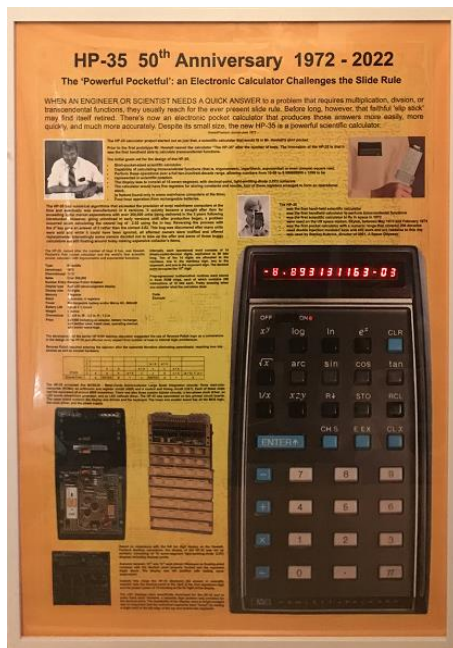
The calibration screen will open where timer calibration can be turned on or off and can be selected to run slower or faster.

Move the correction factor slider to where you think the timing would benefit from. This will have to be done with trial and error to get it spot on. At the maximum setting, the timing error may be noticeable in 10's of minutes. At the minimum setting, the timing change may not be noticeable for hours.

Click [Ok] to send the data to the calculator. These settings will be recalled every time the calculator is switch on.

The original HP-55 timer was specified to work +/- 1.5 seconds in an 8 hour period.

Poster Project



The poster project was created to mark the 50th anniversary of the HP-35 calculator.

The prototype was constructed using an A1 sized poster and comprises no less than 36 circuit boards. One of these is the main circuit board which has the power supply, PIC processor, LED displays and the connections for the 35 key sense boards.

The 35 key sense boards allow the user to simply touch the front glass of the poster panel to activate any of the keys.

See PCB description files in the CalCom/poster install directory.

Features

- Supports HP-35bug, 35, 45, 55, 65, 67, 70 and 80 calculator models
- 15 digit LED display
- Decimal Points are centred in the display like the original
- Up to 7 programs can be stored and used with the HP-55, 65 and 67 models
- 12/24 hour clock
- Display dimming
- CalCom.exe connectivity via a wired connection for data transfers and re-programming

Construction

The project used a standard A1 photo frame. A poster was created using Microsoft Publisher© and then sent to an online printing firm. The file is located in the CalCom install directory and is called `Poster35.pub`. Before sending the document, you must make sure the chosen printing company can use Publisher as the source file. You can also design your own poster image if you like and use it with any of the available emulated models.

The poster frame should not have a thin plastic front like some of the cheaper ones have. A glass front panel is best as it gives a rigid surface for the touch sensors. If flimsy plastic types are used, then key presses may be sensed incorrectly because of the flexing of the panel.

The circuit board designs are in 2 files called `Poster.zip` and `Sensor.zip` and are located in the CalCom/poster install directory. These can be sent to a PCB manufacturer as is. You will need 1 of the Poster PCBs and 35 of the Sensor PCBs to be made. These may be available from the author's web site if enough orders have been placed. If you do get them manufactured, you may like to specify (Black) as the protective colour as this helps hide the board when mounted on the poster board. They are standard double sided.

The circuit boards have surface mount parts on them but can be installed easily as the PCB component pads have been enlarged for home construction. You can follow the construction method outlined here. See - [Parts List](#). There are some extra parts locations on the PCB for a future card reader motor drive but are not required at this stage.

Please note that the semiconductor chips that are used in this project are sensitive to static discharge and can be damaged if proper care is not taken. Please do not hold IC's using fingers, and only hold the PCB by the edges. Personal ground straps are recommended for construction.

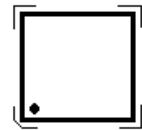


Start with the main display board. There are 4 x 5/32 inch holes needed to be drilled on the board inside the marked circles. Once this is completed, component assembly can take place. Start with the 14 display driver transistors. You will have difficulty mounting these if the displays are mounted first. U2 can be soldered next. The pins are reasonably spaced so soldering should not be too much of a problem. Melt some solder onto one PCB pad (pin 1) and then by using tweezers, position the component in place. Pin 1 is marked on the chip with a dot, and there is an indent on the chip and circuit board pattern at pin1 end. Melt the solder with the iron tip and the chip pin will sink into the solder pool. Remove the iron and solder the pin on the opposite corner of the chip and check orientation before proceeding. If all is well solder the remaining pins and possibly the first again.



The PIC chip can be soldered next. It has 64 pins that are spaced closely together but can be soldered easily with the following method.

Pick a PCB pad on any corner (pin 1) that will be easiest to solder and melt a small amount of solder onto it. Using tweezers, hold the chip in place, checking proper orientation (pin 1 is marked by a chamfer on the PCB overlay and a dot on the actual chip). Use your soldering iron to melt the solder on the pad, and the chip pin will sink into the molten pool, remove the soldering iron and let it cool. Check that the chip is still positioned properly and then solder another pin at the bottom corner along the same side of the chip. Check the position again.



You need to have some Gel Solder Flux for the next procedure. Apply a small amount onto all the PIC pins along a side of the chip that was NOT soldered. Make sure the pins are nicely covered. A chiselled type of soldering iron tip with a small solder well works nicely for the next step. Melt some solder onto the tip then place it over the first pins on the side you are about to solder. Using about 5 seconds total, move the soldering iron down towards the other end and this will solder all of the pins. Have a look at your work to see that they were soldered properly. If you see solder blobs, clean the soldering iron tip and slide it sideways along the PCB surface towards those pins. Once the tip touches the pins, the solder should draw away and remove the excess solder. Solder Wick can also be used, but you need to be careful not to apply excessive heat. Repeat the process for the other two unsoldered sides, followed by the initial side that was tacked down. Re-check your work for shorts and unsoldered pins. A bright light behind the PCB makes it easy to spot shorts. Search [Utube](#) for explanation videos if required.

To mount a part like a surface mount resistor or capacitor, pre solder any one the two PCB pads for the part. Using tweezers hold the component aligned properly just to one side of the PCB pads. With the other hand, re-melt the solder on the pad and hold the soldering iron in place. Slide the component into the melted pool of solder until the edge of the component touches the soldering iron tip. You can move the soldering iron up and down along the edge of the component to make the solder "wet" to the component. Now remove the soldering iron and the solder will cool and solidify quickly. This process should only take a few seconds to avoid overheating the part.

Complete this process for all the other surface mount components and once completed, check your work, especially the orientation of the diodes and capacitors - Tantalums (+ lead is marked with a line on the package). Now go around and solder the unsoldered terminals. Once completed, it is possible that some of the first connections didn't take properly and if you suspect a dry joint resolder it remembering that these components are small and too much heat may damage them.

The leaded components can be mounted next. Please note that some of these are mounted on the bottom side of the PCB so that they don't interfere with the poster front panel.

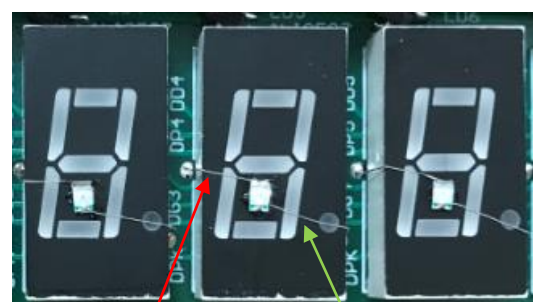
Mount the 15 LED displays next. The ones chosen have black faces so they don't show in the display area. The displays are mounted with the decimal points towards the bottom of the circuit board which is the closest edge.

The Classic LED displays have the decimal point in the centre of the CDEG segments, but displays of this type are not made this way these days. To keep the display as original looking as possible, small LED chips were used as the new decimal points. These LEDs are not soldered to the PCB but need wires attached to them which are then attached to the PCB. These wires need to be very thin so they are not visible unless looking really close at the display. If you look at the Classic LED displays closely, you will see all the internal wiring used in those displays. Only the mantissa digits actually need the decimal points.

This part of the assembly is quite fiddly and time consuming, but I think well worth the effort. To hold these small LEDs while soldering the wires, I used a small alligator clip that was held in a table vice. The actual wires come from the separate strands used in some light gauge hook-up wire. Cut the wire to 60mm lengths and pull the thin wire strands out of the plastic sheath. Clamp a LED into the alligator clip so that one of the connectors is uppermost. Tin the end with some solder and also tin one end of a wire strand. Make sure there is a little bit of solder on the iron tip and hold the wire lengthwise along the LED contact and touch the iron to the contact. This is a bit fiddly for the 11 LEDs that need wires attached. Try not to overheat the LED or it will be destroyed.

The cathode side of these LEDs are marked in green and the wires for these terminals go the right side of the 7 segment displays. The anode wire goes to the left. There are holes each side of the displays for these wires. Using a vice or similar, make sure the display PCB is held steady. Doing one LED at a time, insert the 2 wires but don't solder them to the board yet.

You can try Super Glue for the next procedure, but sometimes it releases a white residue and may not come off the display surface. Otherwise 5 minute epoxy may be used. Place a small dot of glue in the middle of the CDEG segment (lower half of the display). Push the LED down onto the glue and hold it down with a sharp pointed object, like a scribe. Unfortunately, you will have to stay motionless while the glue starts to go off.



Anode

Cathode

Be patient as mistakes will be hard to fix. Once the glue is set reasonably well, gently pull the wires taut and solder them to the underside of the PCB. Make sure the LEDs stay centred.

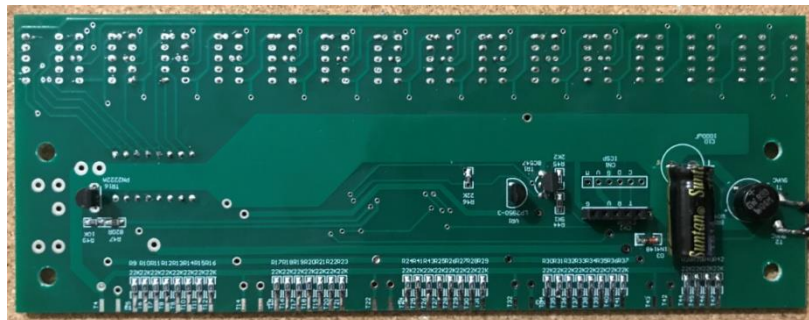
If this part of the project is too fiddly, then the decimal point LEDs in the display can be used instead. You need to join the anode connection to the unused display pin (7) with a short length of wire on the rear side of the circuit board for each of the displays.

You need not use touch sensors for the key operation. Instead you can use a SPST switch of your choice. One side of the switch connects to +5V and the other to the associated key contact. These connections are available in the same positions where the sensors connect to.

The 35 key PCBs can be assembled next. This will take a bit of time so be careful with soldering and parts orientation. Solder the components using the above method, but perhaps pre-solder one pad for each component for all of the 35 boards before adding components. Pre-solder the wiring pads also, 3 at top and 2 at bottom. There is a 3 pin link which controls the Hi or Lo power sense setting. Shorting the left pin to the centre is the HI power mode, and shorting the right pin to the centre is the Lo power mode which is the preferred setting with 35 sensors to power. It takes about 80mS to recognise a touch on the sensor whereas fast mode only takes about 1mS. The 8n2 capacitor is mounted horizontally at the top centre of the circuit board.

Afterwards, check all boards for shorts and sensor chip orientation.

If you have one available, place all the boards in a static proof bag after assembly and make sure the glued LEDs are not disturbed.



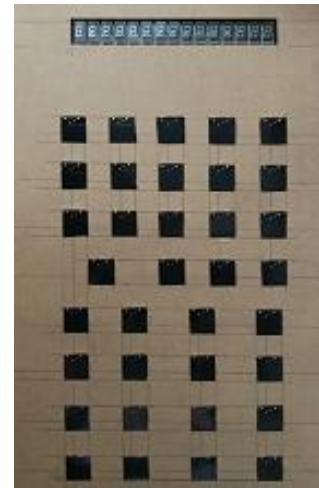
Preparing the poster

The poster preparation depends on how you decide to design the actual poster. You may have used a calculator image size that is not quite the same as the one described. If so, you must make sure the display digits on the PCB fit nicely into the calculator LED area.

For this project, a display area was cut out of the poster print measuring 185mm x 15mm, making sure that it was well centred in the calculator display area. The poster can be expensive to get printed, so care should be taken. A box cutter with a new blade works well. To act as a guide, a metal or plastic ruler can be placed along one of the longer edges. Sometimes the ruler may move while cutting takes place, so it can be held in position with some adhesive tape. If you do this, make sure the tape does not adhere so well that the poster tears on removal. Now while holding the ruler, use the box cutter to make the cut. Repeat the process for the other long side and then cut the shorter ends.

Place the poster over the poster frame rear panel, which is usually made out of stiff card about 3mm thick. Mark out the display hole. Expand this hole outward by about 5mm on all edges. Note that the image shown here was a prototype and is marked slightly different.

If you turn the poster face side down and can get a light source behind the poster you can see where all the button centres are. You can mark each point on the back of the poster with a marker and then transfer the button centre measurements to the poster backing board. Draw lines linking all and extending through the new centre marks, horizontally and vertically. The lower buttons will not be vertically in line with the top three rows, neither will the ENTER button.



The key PCBs are 23mm square but the sensor area under the pads is offset from the centre by 2.5mm. The key PCBs have centre markings on the edges of the component side and these can be used to offset align the PCB to the lines just marked on the board. Once aligned, use a marker to mark out the square around the PCB and complete for all buttons.

The backing board is reasonably soft so you can use a small thin sharp chisel and hammer to remove the key and display holes from the board and this can give straight edges with sharp corners. Drilling corner holes and using a jigsaw might be too harsh on this type of material.

Cut some of the 0.3mm red clear plastic film about 20mm larger than the hole that was cut out of the poster. Use some adhesive tape to hold it in place on the rear side, making sure that no tape appears in the window area.

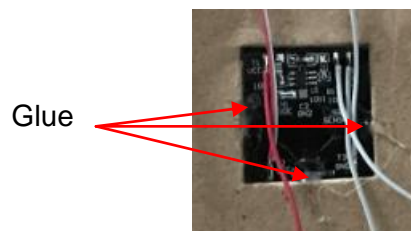
Position the display PCB onto the backing board so that the displays are centred in the cut-out area. The prototype used 10mm square wooden strips to hot glue across the backing board for adding a bit of stiffness and to mount the PCB onto. You can also use threaded plastic standoffs cut to right length to support the PCB on the backing board if desired. The standoffs or wood spacers should be wide enough to make



sure the face of the LED displays is not protruding past the front of the backing board. The stand-offs can be hot glued to the backing board if required. If you use screws to secure the PCB as shown, use oversize holes so that some positioning adjustments can be made. Also, use taper head screws and counter sink the holes in the poster board face so that the poster sits flush on the front face. Note that this image was still in prototype stage and had some additional circuitry clipped to the side.

Place the poster board front side down on a flat surface so you are looking at the rear of the panel.

Insert the sensor PCBs into the cut out holes from the rear of the panel so that the component side is up. The sensor IC should be towards the top. Each sensor board should now be sitting flush with the front of the poster board. If all is well, use a small dab of hot glue on the left and right side of the PCBs to hold them in place. You can also use a small dab on the bottom edge between the 2 wire connector pads. Repeat the process for all of the boards. Once glued, try not to flex the board to much while handling.



The hot glue hardens fast so once that is complete, the key wiring can be connected. The circuit board has 5V power for each of the 5 columns of keys and a connector for each key in that row. IDC cable can be used to connect the key sensor boards to the main board.

Start by pre-soldering all of the wire connection pads along the top edge of the display circuit board.

IDC cable has a red wire on one edge and can be used for the Vcc (+5V) connections. Separate two wires (including the red one) for the full length keeping them attached to each other.

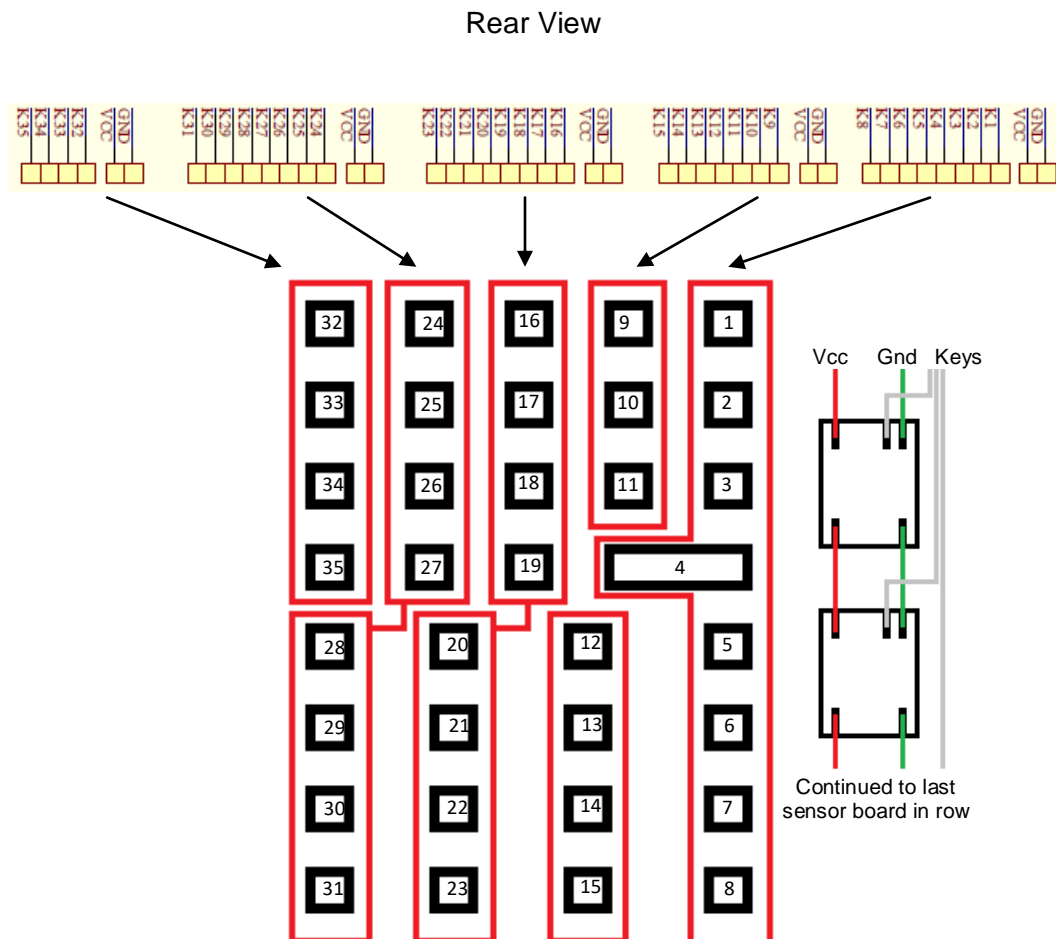
Lay the 2 strand IDC cable from the connection points on the main board down to the top left sensor board. Allow a bit extra for the connection and cut to length. Strip about 3mm of insulation from each wire end, twist the strands so they are neat and tin with solder. Taking care, at the display board end, solder the red lead to the VCC connection and the grey wire to the GND connection. Solder the other ends to the VCC and GND connections of the left upper most sensor board.

Measure the distance from the bottom of the sensor board to the top of the next lower and cut, strip and tin the wire ends. Connect the bottom of the first sensor board to the top of the second board. Complete these "daisy chain" connections until the bottom sensor board is completed. Repeat the process for the other 4 columns of sensor boards.

Separate 8 wires from the IDC cable leaving them all connected together. Repeat this another 2 times. Now Separate 7 wires from the IDC cable, and finally separate 4 wires from the remaining cable. For all wires, strip, twist and tin at one end only.

Choosing the left most column first, solder the wires to the 4 connectors on the display board. Split the K32 wire from the lower end of the 4 wire cable until it reaches the lower edge of key sensor board [32]. Cut the end of the wire leaving about 40mm of single strand

at the end. Strip, twist and tin the wire end. Then bend it 180 degrees upward and solder it to the key connector on the top edge of sensor board [32]. Repeat the process for the other 3 sensor boards. Using the diagram below as a guide, move to the next column and repeat the wiring process for those 8 boards. Complete the remaining columns in the same way. Check your work making sure you didn't transpose the polarity of any of the power wires or change the order of the key wires.



The AC power connector can be fitted above the bottom frame piece with a small right angle piece of metal or plastic so that the entire plug assembly from the AC supply is hidden from view. This way, only the wire is visible from the bottom. Connect the figure 8 wire from the connector to the AC connect pads on the display PCB.

Calculator Menus

The poster calculator has menu selections that can be accessed by holding your finger on the top left sensor button for at least half a second.

Navigation Keys

ENTER	Selects the menu item.	+	Next menu item
CLR	Reverts to the root directory	-	Previous menu item
CLR	Exits menu mode if in root directory		

Display Icons	=	Menu has sub directories	⊢	Displayed option is active
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Select Calculator Type

HP-35, HP-35 LN bug, HP-45, HP-55, HP-70, HP-80, HP-65, HP-67

Calc ID Show

ID On Show calculator ID at power on
ID Off Do not show calculator ID at power on

Anniversary Model

As you can make a 50th anniversary poster for any of the available models, "50th" can also be displayed alongside the calculator ID on power up if the anniversary model selection matches the calculator selection.

HP-35, HP-35 LN bug, HP-45, HP-55, HP-70, HP-80, HP-65, HP-67

Clock Setup

Enable

Clock Enabled
Clock Disabled

Note: When the clock is enabled, any key press will switch back to calculator mode

Clock Set

Use number keys 0 - 9 to set 24 hour time.

Clock Display Brightness

LED Hi
LED Lo

Clock 12 24

Clock 12
Clock 24

Clock Seconds Display

Seconds On
Seconds Off

Clock Frequency

Freq 50
Freq 60

Run Select Run Switch for HP-55, 65 and 67

Program Select WPGM Switch for HP-55, 65 and 67

Timer Select Timer switch for HP-55

Store Select a program
+ Next program
- Previous program

Recall Select a program
+ Next program
- Previous program

All of these menu items can be accessed from the CalCom program via the FTDI USB connection. To access them from the CalCom program, set the Option to [Info] and press [Write].

Programs can be transferred to and from the poster by selecting the [Program] option and entering a program number [0..7], plus ENTER, and then pressing write or read.

When writing a program to the poster, not all alphanumeric characters can be shown on the LED display, so you will have the option of editing the name of the file so that it can be displayed in 7 segment format.

Note: When using the FTDI board, it supplies power to the circuit and must be set to the [5V](#) position. The PICkit3 also supplies power to the board.

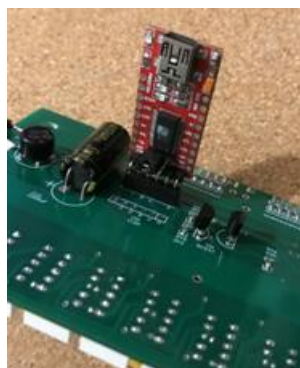
Note: Make sure the 9VAC power source is disconnected when using the FTDI or PICkit3.

Reprogramming

The PIC chip can be reprogrammed using an FTDI USB convertor board or by using a PICkit3 programmer.

The FTDI board is connected to the PC via a USB cable and connects to the CalCom program. See [details](#).

It connects to the display board as shown. Note, that the lower connector is for the PICkit 3.



A PICkit3 programmer can also be used to reprogram the PIC device if the FTDI procedure fails for some reason. There is no connector for the PICkit3, just the PCB holes. Once the programmer connector is inserted into the holes, it can be held in place with light sideways finger pressure on the face of the programmer. There are no programming switches on the Poster board.

See Programmer [details](#).

The file to use for this procedure is called `Poster.hex` and is located in the CalCom `install/Poster` directory.

Alternative parts suppliers - Digikey, Mouser, Hobby suppliers etc
Note that some parts were sourced on the web as they were much cheaper.

Part	Type	Style	Qty	Reference	Supplier
Main Board					
Circuit Board			1	Poster.zip	PCBway
PIC18F66K40	Microchip	TQFP	1	134-5624	RS Components
LED Display	Common Cathode	0.4in Red	15	Note 1	Ali Express
LED	Red Super Bright	0805	11	Note 2	Ebay
A2982SLW/TR-T	Hi Side Driver	Surface Mount	1	680-7220	RS Components
MMUN2235LT1G	Digital Transistor	SOT-23	15	2724472	Element14
CF4532	Priority Encoder	SOIC	1	3119860	Element14
LP2950	5V Reg Low Dropout	TO-92	1	3007573	Element14
BC547	NPN Transistor		1	1574381	Element14
W04	Bridge Rectifier		1	1861437	Element14
IN4002	Rectifier	DO-214AC	1	1459137	Element14
IN4148	Rectifier	1206	2	2306145	Element14
IDC	Pin Header Socket	6 way	1	159346202	Element14
IDC	Pin header	2 way	1		Jaycar (Aus)
IDC	Shorting Link		1		Jaycar (Aus)
1000uF 25V	Electrolytic Cap	Radial	1	9451226	Element14
100N	Ceramic Cap	1206	4	1362554	Element14
10uF 16V	Tantalum Cap	1206	1	1650980RL	Element14
4u7 10V	Tantalum Cap	1206	5	498658	Element14
2K2	Resistor	0805	1	2447623	Element14
9K1	Resistor	0805	1	2447739	Element14
22K	Resistor	0805	36	9334157	Element14
220R	Resistor	Radial	7		Jaycar (Aus)
470R	Resistor	Radial	1		Jaycar (Aus)
Cable	IDC	50 way	1 Mtr	WM4508	Jaycar (Aus)
Cable	Twin Figure 8	PCB PWR	1 Mtr		Jaycar (Aus)
Optional Parts for Motor Driver (Not developed in PIC code yet)					
2N2222	NPN Transistor	TO-92	1	1704853	Element14
IN4002	Rectifier	DO-214AC	1	1459137	Element14
820R	Resistor	0805	1	163254502	Element14
10K	Resistor	0805	1	163254502	Element14
Small DC Motor and gears					
Sensor Boards					
Circuit Board			35	KeySense.zip	PCBway
AT42QT1010	Capacitive Touch	SOT-23	35	1841593	Element14
100N	Ceramic Cap	1206	35	1362554	Element14
8N2	Ceramic Cap	0805	35	1759245	Element14
10K	Resistor	0805	35	2073612	Element14
Sundries					
PCB Mounting hardware as desired					
Solder Gel Flux			1	H1650A	Altronics (Aus)
Screw	5/32 x 25mm	Taper Head	4		
Nut	5/32		4		
Washer	5/32		4		
Wire	2 strand	1A	1 metre		
Wall Wart	9V AC	150-500mA	1	MM2006	Jaycar (Aus)
Connector	2.5mm Bulkhead	DC	1	PS0524 Note 4	Jaycar (Aus)
Plug	2.5mm	DC	1	PP0511	Jaycar (Aus)
Hot Glue					
Poster	A1				
Poster Frame	A1				
Plastic Film	Red	0.3mm	1 Piece		Note 3

Note 1

<https://www.aliexpress.com/item/4000311224093.html?spm=a2g0s.12269583.0.0.762f758bwWRErC>

Note 2

[https://www.ebay.com/itm/391346112199?ViewItem=&item=391346112199&v=1&utm_source=unp&utm_medium=email&utm_campaign=RT000090&utm_unptid=&ppid=RT000090&cnac=AU&rsta=en_AU\(en-](https://www.ebay.com/itm/391346112199?ViewItem=&item=391346112199&v=1&utm_source=unp&utm_medium=email&utm_campaign=RT000090&utm_unptid=&ppid=RT000090&cnac=AU&rsta=en_AU(en-)

[AU\)&cust=&unptid=&calc=174775b8313a6&unp_tpcid=null&page=main:email:RT000090&pgrp=main:email&e=cl&mchn=em&s=ci&mail=sys&appVersion=1.27.0&xt=104038](https://www.ebay.com/itm/391346112199?ViewItem=&item=391346112199&v=1&utm_source=unp&utm_medium=email&utm_campaign=RT000090&utm_unptid=&ppid=RT000090&cnac=AU&rsta=en_AU(en-AU)&cust=&unptid=&calc=174775b8313a6&unp_tpcid=null&page=main:email:RT000090&pgrp=main:email&e=cl&mchn=em&s=ci&mail=sys&appVersion=1.27.0&xt=104038)

Note 3

<https://www.ebay.com.au/itm/202465126036>

Note 4

The actual connector may depend on the AC adaptor used.

HP-97 Operation

[Installation](#)

[Menu Access](#)

[Printer Type](#)

[HP-97S Mode](#)

[PC Communications](#)

[Software Reflash](#)

Power Requirements

The board has been designed to work from the HP-97 5V battery. Although the original charge system is incorporated on the board, the CPU board itself will not work from the charger alone. This is because the charger has an AC output voltage that is rectified on the board but this alone will not power the board and it may work erratically.

If required, a separate 5V 3A wall wart supply may be used to power the 97 from the mains. In this case, the battery should not be used as this type of power supply is not regulated sufficiently for battery charging.

The circuit board is sensitive to static electricity damage. Please handle the board only by its edges, never by touching the components. This is especially important when unpacking the board prior to installation.



While the calculator is apart, it might be useful to lubricate the printer as per the directions given in the HP-97 Service Manual. If the printer parts are sticky due to dried out bearing components, the printer may not print evenly.

If you suspect the card reader is suffering from the “gummy wheel” problem, this should be repaired as well.

CAUTION:

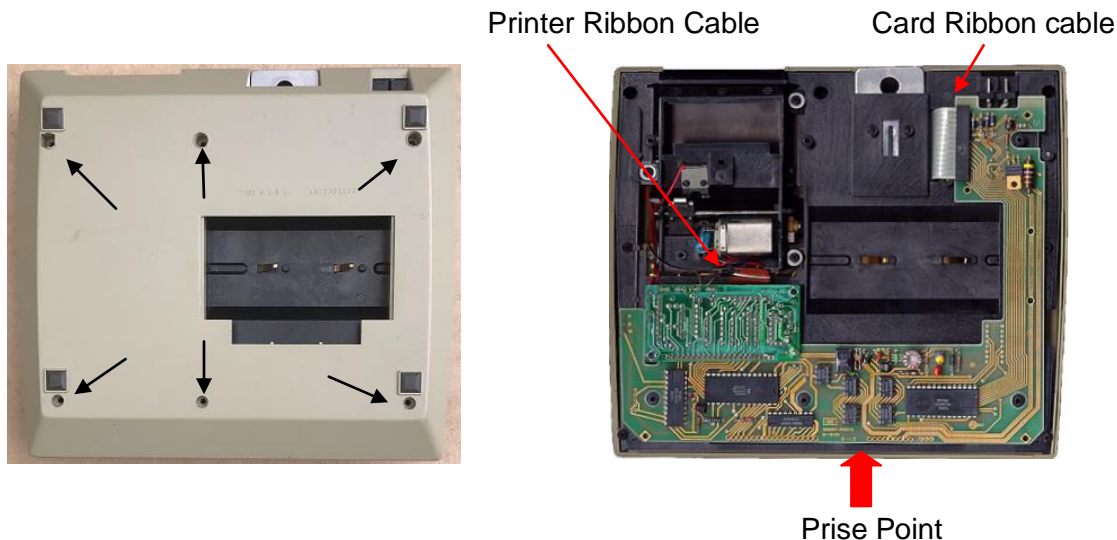
Turning this CPU board on with reversed battery connections will result in damage to the power supply input capacitor and the printer motor driver IC. These two components are connected directly to the battery supply through the power switch.

Installation

Unclip the battery cover and remove the battery.

Tools required: Phillips-Head screwdriver, Flat blade screwdriver, soldering iron, solder.

The circuit board is easy to install. To begin, turn the HP-97 upside down and remove the 6 rear cover screws with a Phillips-Head screwdriver.



Remove the printer driver circuit board by gently prising the board upwards to disconnect the pins. Carefully remove the six wires that connect to the print motor, paper out switch and carriage home switch.

The printer ribbon cable can be removed next.

NOTE: DO NOT PULL THE RIBBON CABLE OUT DIRECTLY OR IT WILL BE DAMAGED.

You need a special tool to remove this cable because it is held captive in its socket.

On the Teenix web site, there is a download file call [ClassicNotes.pdf](#). Near the end of this document there are some details on how to make and use such a tool.

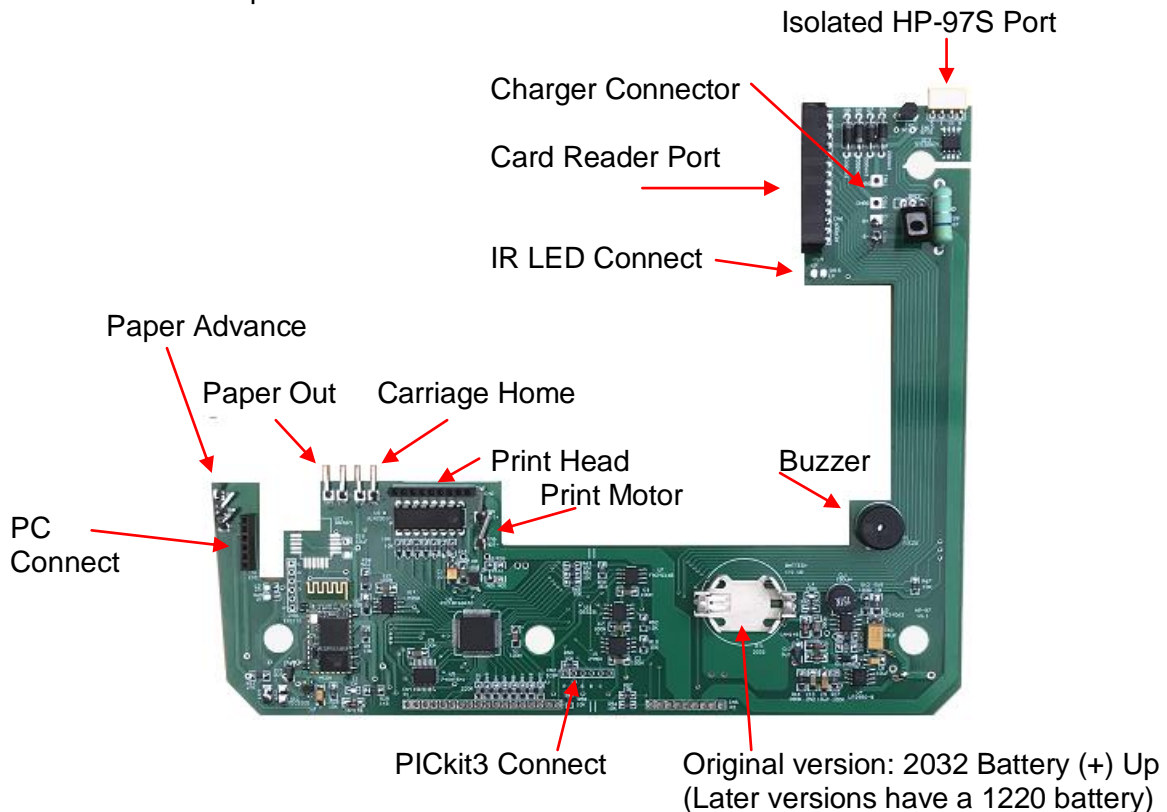
Once the ribbon cable is removed, the printer driver board can be removed and stored somewhere safe.

Remove the card reader ribbon cable next. This can be removed by carefully pulling the ribbon from its socket.

The CPU board can now be removed.

Use a finger nail or small flat bladed screwdriver to lift the board at the “Prise Point” shown above. This should raise the board away from the keyboard connectors. Please be careful with these connectors. If they bend in any way, they may snap and will be very hard to repair.

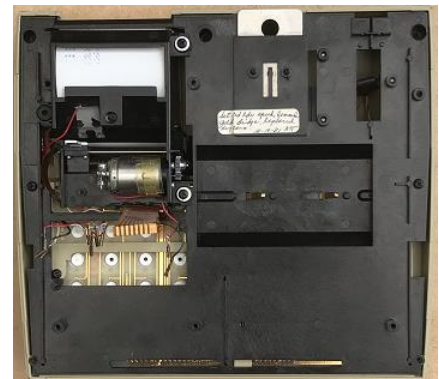
Circuit Board Components



There are three wires that connect to the printer paper advance switch underneath the left side of the board. These can be removed using needle nose pliers.

On the right top end of the board, there are two wires that connect to the charge socket. The socket can be removed from its mounting point by lifting it upwards.

Underneath the top right end of the board, there are two wires that connect to the battery. These can now be removed from the connector pins.



The CPU board can now be removed from the calculator.

The two wires that connect to the charger socket need to be un-soldered from the circuit board using a soldering iron. Support the board, either in a table vice or with the help of someone else and place the tip of the iron on the contact on the upper surface of the board. Once the solder melts, pull on the wire to remove it. Repeat the process for the second wire.

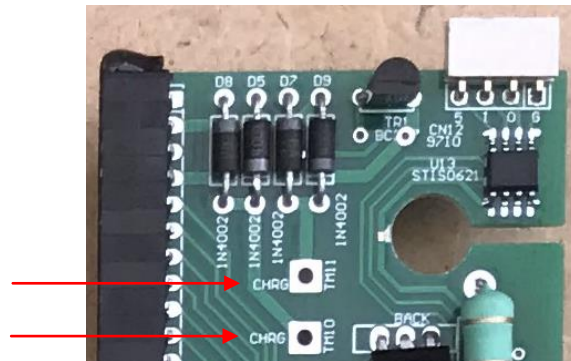


Keep the charger connector as it needs to be soldered to the new CPU board if you still want to use the original battery charger.

To protect the original CPU board while in storage, place it in a static proof bag or wrap in aluminium foil.

Note: The new CPU board can also be damaged by static electricity. Handle the board only by the edges.

If you removed the charge connector, while the soldering iron is hot, unwrap the new CPU board and solder the charger wires to the same points on the new CPU board.

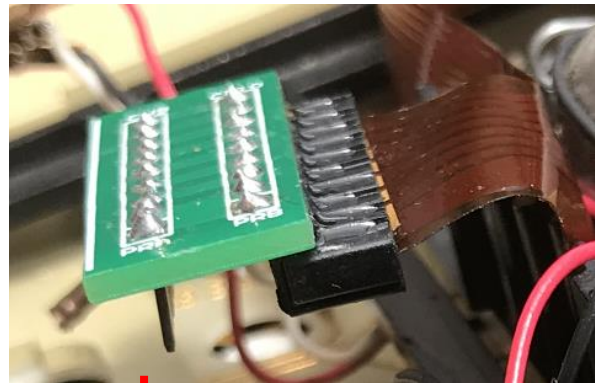


There is an infra-red LED soldered to the CPU board with flying leads. If you require the LED to connect to a HP-82240A/B type of printer, then a 3mm hole should be drilled into the rear of the bottom casing where the security cable connector is located. This would have been the place where a cable exited if the calculator was a HP-97S type. The led can be placed through this hole and the wires can be fixed into place with tape or similar later on.

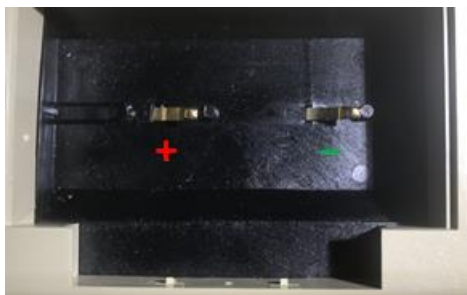


Make sure the three wires that connect to the paper advance switch are coming out of the larger hole in front of the printer, not through the smaller hole where they were originally.

There is a small connector board that is included with the earlier version CPU board, the later versions have this board fixed to the main board. This connector is used as a receptacle for the print head ribbon cable. There are nine connector pins on the underside of this board. These need to be pointing down when connecting the ribbon cable. The ribbon connector on this board is not a captive type so the ribbon cable can be removed and inserted easier than the original and does not require a tool.



Carefully but tightly hold the small board in one hand while inserting the ribbon cable into the socket with the other. Be extremely careful not to stress the ribbon cable especially where it connects to the print head. It would be very difficult to repair any damage to the ribbon itself. Once inserted, loosely place the connector and ribbon behind the print motor.



Reconnect the battery leads from underneath the board **taking a lot of care with the polarity of the wires**. The red/white +ve lead connects to the **B+** connector, which is closest to the charge connectors, and the solid red wire connects to the **B-** connector. Verify this on your calculator if you have a ohmmeter.

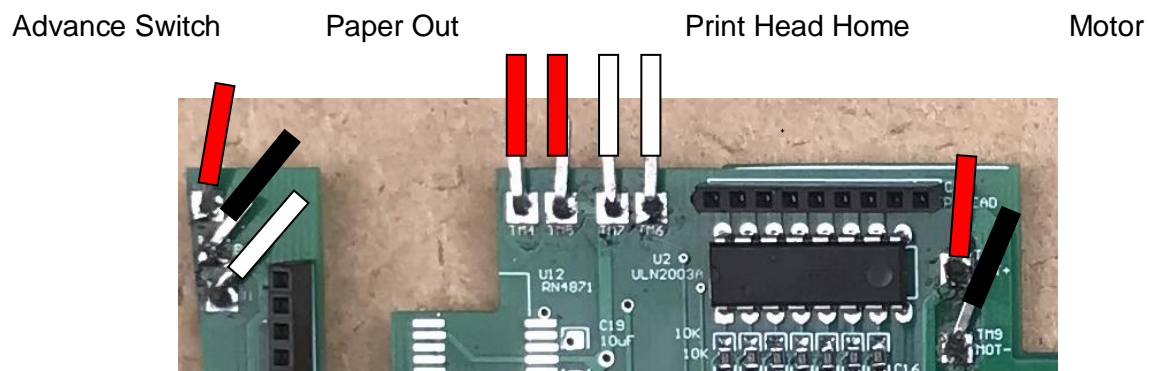
Note: Connecting the battery the wrong way around will cause damage to the CPU board and possibly other original components.

The new CPU board can now be placed into the calculator body. Handle the board by the left and right edges, and carefully line holes in the board up to the 3 screw pillars moulded into the calculator frame. Now manoeuvre it gently to place it over the connecting pins so that they all line up properly. A bright light can help see the pins through the holes.

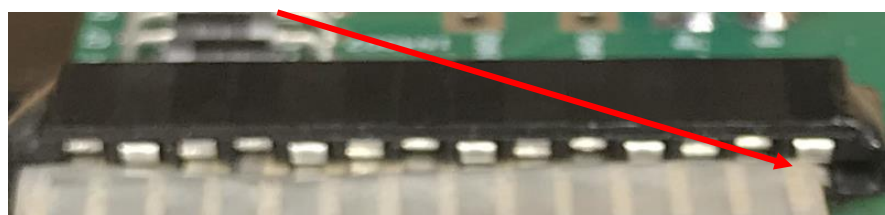
Note: Do not force the CPU board onto the key board pins or they might bend and break.

Once lined up properly the board should easily slide down into place. With light pressure, push the board down left, centre and right of the pins so that it is seated properly.

The wiring can now be connected to the board as shown below. Carefully check the *Print Head Home* wires and if possible verify the switch works with a multimeter. The white wires should register a short circuit when the print head is homed. If not, you may need to check for broken wiring or a broken switch, which is a magnetic reed type. If these items are not connected and working properly, the CPU will try to home the print head when it is switched on. The motor will automatically switch off if not homed within a short time, however the motor may still be trying to turn with the head homed and may cause damage to the soft idler cog.



The card reader ribbon cable can be installed next. The socket for the ribbon cable has 14 pins instead of the 13 on the original CPU board. Unfortunately, 13 pin connectors were unavailable. When inserting the cable into the socket make sure it is lined up with the left most pin in the connector and all pins line up with the ribbon cable connections. The far right hand pin nearest to the IR LED cable should be vacant. This pin may have been removed from the socket.



Recheck the wiring and board position and if all is well, make sure the calculator is switched off and in RUN Mode, and insert the battery. Leave the battery cover off and the calculator upside down. While making sure the battery is secure, slip your finger under the right side of the calculator and turn the calculator on. If the CPU board is functioning properly, you should see a LED flash briefly. If you lift the calculator slightly, you should see **0.00** displayed. Turn the calculator off and remove the battery. If the print head was not in the home position, it should have homed when the calculator was switched on.



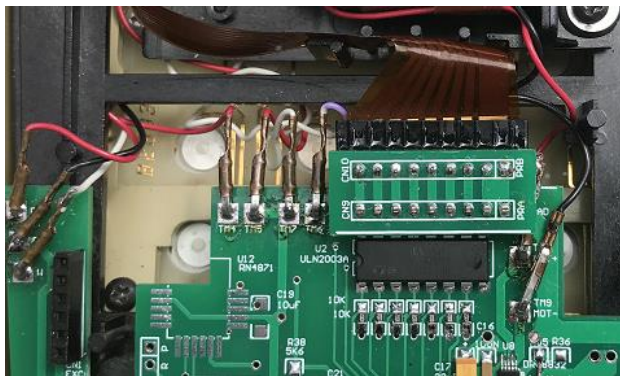
Note: Some boards may have a battery receptacle for a 1220 size battery.

If required, the IR LED can be mounted on the rear panel and secured with tape on the wiring if need be. Otherwise it can be secured inside the calculator above the battery compartment or the wiring can be un-soldered from the circuit board.

If you would like battery backup for the inbuilt clock, please insert a 2032 (or 1220) type now.

Make sure the (+) side is UP.

The printer ribbon cable can now be carefully threaded back through the retaining fingers just in front of the motor and the connector pushed into the socket on the CPU board. Make sure the connector pins are lined up properly or print head damage may occur.



Re-fit the back cover and secure it with the six screws. Then insert the battery and its cover.

Turn the calculator right side up, switch to RUN and switch on. If all is well **0.00** should be displayed. You should be able to feed paper into the printer using normal procedures.

If the display is not correct or the printer will not function, there could be a problem with the keyboard components, print motor, advance switch and or the wiring is faulty. If this is the case, then unfortunately the new CPU board cannot repair those problems and some other repairs will be needed.

The calculator defaults to *Continuous Memory* mode so this will be enabled already. This mode will maintain all memory and programs, the X register, Last X and Deg/Rad/Grd Mode when the calculator is turned off.

The *Continuous Memory* requires no power at all to retain memory so it will be maintained indefinitely even if the HP-97 and clock batteries are removed.

The clock will maintain its time information while the calculator is turned off, even if the HP-97 battery is removed, as long as a charged 2032 (or 1220) button battery is connected.

Printer Use

Speed

The printer speed and intensity can be adjusted via the calculator menu or from the CalCom program. It is important to realize that the HP-97 printer has no mechanical safety mechanisms in case of malfunction. For instance, if the HOM switch fails, the motor will continue to drive the print head into the side of the printer casing and could either burn the motor out, or strip the gears on the plastic print drive intermediate gear.

The new CPU board software monitors the HOM switch when reversing the print head. Once this reversal starts, a countdown timer is activated and if the HOM switch has not closed before timer expires, the print motor will shut down and an error message will be displayed. Even so, the print head could still butt up against the printer frame.

Neither the original Printer Interface Keyboard (PIK) controller, nor the new CPU board, knows the position of the print head once it leaves the HOM position. If the print head speed is adjusted too high, then before the print line completes, the print head will butt up against the left side of the printer frame and may cause damage.

The printer speed is set to the middle setting as default and should print normally, but if the printer speed needs adjustment, care is needed to avoid the damage mentioned above.

If the print line is too short, you can speed up the print motor by adjusting the print speed setting, but do this with small changes, not large ones. It is best to print a short line, then a medium sized line and then a full line by progressively adding digits to the displayed number to print. If it looks like the printer will overrun the print paper, use a smaller print speed value.

Intensity

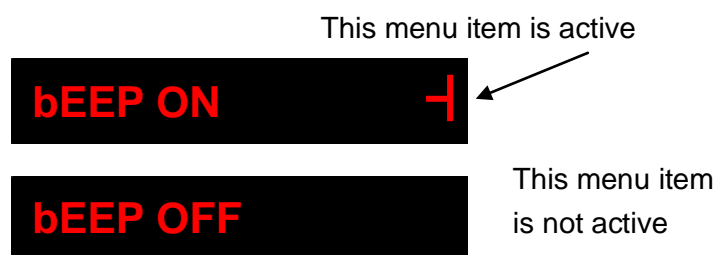
Due to the age of the print head, it would be prudent to keep the print intensity as low as possible while still maintaining readability. Of course this is up to the users preferences, but it could reduce the stress on the print head elements.

Menu Access

The inbuilt menu system can be accessed by holding down the [f] key



If the Sub Menu character is displayed, pressing [ENTER] will open the sub menu.



To select a menu item, press [ENTER]

To exit a menu level, press [CLx]

The HP-97 menus work similar to the other CPU boards. To view other menu explanations see [Menu Mode](#).

Menu Structure – Descriptions available in [Menu Mode](#) unless mentioned here.

Card
Clock
Connect Y N
Options

Clock

The clock menu will display the current time. Once in this mode, the keys [A] through [F] allow viewing and setting options.

- [A] Displays Time
- [B] Displays Date
The date can be displayed in DD MM YYYY or MM DD YYYY formats
The day of the week is shown in the right mode digit. 0=Sun -> 6=Sat.
- [C] Displays Alarm Time

- | | | |
|-----|---------------------|-----------|
| [D] | if Time is showing | Set Time |
| | If Date is showing | Set Date |
| | If Alarm is showing | Set Alarm |

Time Set

The time is set in 24 hour mode

Enter the time as HH MM SS using the digit keys

If you make a mistake, keep entering digits and they will start to overwrite the shown time after the seconds are entered.

- | | |
|---------|-----------------|
| [ENTER] | Accept changes |
| [CLx] | Discard changes |

Date Set

Enter the data as: dd (01 – 31) mm (01 – 12) yy (00 – 99)

The year century defaults to 20.

Alarm Set

The alarm time is set in 24 hour mode

Enter the time as HH MM SS using the digit keys

If you make a mistake, keep entering digits and they will start to overwrite the shown time after the seconds are entered.

- | | |
|---------|-----------------|
| [ENTER] | Accept changes |
| [CLx] | Discard changes |

- | | | |
|-----|---------------------|---------------------------------------|
| [E] | Alarm On Off Select | (Only available if time is displayed) |
| | [X<>Y] | Toggles the available selections |
| | [ENTER] | Accept Change |

- | | | |
|-----|---------------------|---------------------------------------|
| [F] | DDMM or MMDD Select | (Only available if time is displayed) |
| | [X<>Y] | Toggles the available selections |
| | [ENTER] | Accept Change |

- | | |
|-----------|---|
| [Print X] | (Only available if time is displayed) |
| | Prints the current time to the selected printer |

Note: The clock can also be accessed from normal Run Mode by pressing [f] [3].

This will remain on display until a key is pressed, a card is entered or PRGM Mode is selected.

While the clock is displaying in this mode, you can press [X<>Y] to swap the display between Time and Date.

You cannot edit the time or date in this mode.

Options

Most options have 2 menu items associated with them to either activate the item or deactivate it.

FRAM	Off	On	Initialise
Card Oride	Off	On	
Model Number	Off	On	
Debounce	Low	High	
Beeper	Off	On	
Alt Functions Mode	Off	On	[f] [f] function keys
Printer Type	HP	IR	
Pgm Display	Off	On	
Version	Displays firmware version number		
Print On Off	Turns the internal printer on or off		

The next two Option Items allow adjustment of the HP-97 printer.

Printer Speed
Printer Intensity

FRAM

When enabled, the *continuous memory* will be preserved at switch-off. When disabled, the memory will work the same as a normal HP-97.

FRAM initialise, clears the continuous memory.

Card, Card Oride, Model Number, Debounce, and Notes mode work as per the HP-67 menu items. See – [Menu Mode](#).

Beeper

The beeper will always* sound if any operational fault occurs, such as bad memory access, a printer error, or for the clock alarm. It will also sound when a running program stops. The beeper can be disabled from the menu if required, however, error beeps will still occur.

- 1 = program stopped
- 2 = program error
- 3 = PC Buzz Test
- 4 = * Printer did not home on when calculator turned on
- 5 = * PIC code execution error

Pgm Display

This mode will display the program steps as text on the LED display instead of key positions.

x and <> cannot be displayed on 7 segment LEDs, so X is shown as a decimal point and <> is displayed as a 3 horizontal LED segments.

If a program code is a shifted function like [f] $X \neq Y$ then \overline{F} will be shown at the right of the display,

Examples...

$\overline{F} \ X \neq Y?$

003 .nEqY? F

$X < > Y$

001 . = Y

CLx

002 CL.

Printer Type

The HP-97 CPU board can print on its own internal printer or via an Infra-Red link to a HP-82240A/B printer. To do this, the IR LED must be mounted properly and the IR Printer is selected from the menu.

The HP-82240 printers do not have handshaking protocols so the 97 CPU board has to wait until a full IR data packet has been sent to the printer and then wait until the print operation has completed. This can take around 2 seconds for each line to print so for operations like printing a program, it will be quite slow.

Because of the accuracy required, all 97 CPU operations are suspended while the IR data is being transmitted to the printer. As such key presses will not be recognised until the printer actually starts to print.

Printer On Off

This menu option turns the original printer on or off. Disabling the printer can be useful if the printer mechanism is faulty and is not worth using. The HP microcode will function normally with the printer turned off so if you try to print a program, for example, there might be a small delay where nothing appears to happen.

Quick Card Load/Save (HP-67 and HP-97)

If a card is loaded or saved from the menu and it is part of a 2 card set, **Crd** is shown on the display prompting for the next card.

If the [ENTER] key is pressed, the next card will be loaded automatically and will save starting the menu and manually selecting the card.

For example, if the first card was loaded from Block [0] Program [10] and **Crd** is displayed, pressing [ENTER] will try to load the next card from Block[0] Program [11].

If there is no card available in the next program address, or the first card was the last card in the selected Block, the function will fail.

HP-97 Alt Functions Mode

The HP-97 has minor differences in the way the Notes Mode works compared to the other CPU boards.

- Only 80 notes can be displayed (0 – 79)
- Each note can have up to 20 characters
- Notes are not shown on the LED display
- Notes are printed on the selected printer

During normal operation, every key on the HP-97 is used, so the simplest way to activate notes mode is to double press the [f] key.

[f] [f] [A]

This key sequence can be entered into a program and will be stored as 1 step.

When entered or executed from a running program, the current time and date will be printed to the selected printer.

[f] [f] [B]

This key sequence can be entered into a program and will be stored as 1 step.

When entered or executed from a running program, the note determined by the X register value will be printed to the selected printer.

Using the X register to select a note

Any number that represents 0 – 79 can be used as a note index.

The index numbers 0 – 9 can be entered as a single digit.

Example:	Key [1]	note 1 access
	Key [0] [7]	note 7 access
	Key [6] [7]	note 67 access

Positive numbers > 79 or negative numbers will access note [0]
Only the integer portion of the X register is used.

Notes can be created when using the CalCom program and can be uploaded to the calculator from the FTDI link or via Bluetooth.

[f] [f] [C]

This key sequence can be entered into a program and will be stored as 1 step.

When entered or executed from a running program

- if the X register = 0 then 67 Print Mode = False
- if the X register = 1 then 67 Print Mode = True

When the 67 print mode = True, some print functions execute like the HP-67.

- Print X Displays the X register
- [f] Print X Displays each stack item
- [f] ENG Displays the registers in turn

HP-97S Mode

This mode of operation can be enabled/disabled from the menu.

When enabled, the CPU board will listen for commands from the 97S isolated serial port at the rear of the calculator.

Just like the real HP-97S, there is no way to determine in advance as to what will be connected to the interface by the user.

To simplify the interface, the communications is via a simple RS-232 serial port. The port does not have DTS style handshaking but is implemented within the data being transmitted.

The serial port operates at 19200 baud, no parity checking and 1 stop bit. (8 N 1)

The port must be controlled by some other equipment with a matching serial port such as:

- Any microcontroller project
- PC program
- Arduino Project
- Raspberry Pi

The 97S function should be enabled only after connecting a suitable interface. If it is enabled while a connection is made or broken, invalid data might cause the software to keep expecting more data and freeze the system. In such cases, this information is not kept in continuous memory and the HP-97 can be switched off to clear everything.

It is possible that erroneous data is fed to the 97S port causing problems with buffer overflows. If this happens, the 97S mode will shut down and a message will be shown on the LED display.

Just like the original 97S interface, it is up to the user to determine how the data is to be represented. The interface only expects up to 10 BCD digits of data to act on and this data will appear in the X register and can be processed further if required.

Note that as digits are treated as pressed keys, the internal Flag 3 will be set = True. When this happens as per the 97S manual, the interface adopts a *Not Ready* state. This flag can be cleared as normal in a program or from the 97 keyboard.

COMMAND SET

There are only 2 commands available. Do not send commands continuously without waiting for an acknowledge. Failure to adhere to this will overrun the receive buffer in the 97S and the 97S mode will switch off.

```
cmdReqStatus  
cmdDigits
```

cmdReqStatus

This command, sent to the 97S, requests the current Status Flags Register value.

Value	\$F0 (240 dec)	
Returns	1 byte	Status Info

Status Bit Definitions:

7	FlagChanged	1 = 97 Flags changed state
6	Reserved	
5	Reserved	
4	Ready	1 = Ready
3	Flag_3	1 = Set
2	Flag_2	1 = Set
1	Flag_1	1 = Set
0	Flag_0	1 = Set

Every time the 97 Microcode changes the state of its internal flags (Flag 3 for example) or the user changes the any of the flags by pressing something like [f][STF][0], the Status Register will be automatically sent to the interface with `FlagChanged` set = 1, and the updated bits for the flags state. This tells the interface that a flags change occurred and this data can be used to mirror the state of the flags to output pins on the interface.

The `Ready` flag is cleared to 0 as per the states listed in the 97S manual. Digit data should not be sent to the 97S unless the `Ready` flag is set to 0 or the data will be ignored.

Note: The ready flag is cleared to zero if the 97 is placed in PRGM Mode;

Flag_0 to Flag_3 mirror the states of each of the 4 internal 97 flags.

cmdSendDigits

This command, sent to the 97S, informs it that up to 10 new BCD data bytes are available from the interface.

Value	\$F1 (241 dec)	
Returns 1 Byte	\$F1 (241 dec)	Ready to receive single BCD byte – Ready = 0 Any other value, the 97S is not ready, abort the transfer request

Send BCD Digit

Returns 1 Byte	\$A0 (160 dec)	Digit data is accepted and is converted to a key code and placed into a digit buffer.
	\$A1 (161 dec)	Digit buffer full, 10 BCD digits have been received This will terminate the BCD digit transfer. The ready flag will be set to 1 after all digits processed
	\$A2 (162 dec)	The 97S has waited too long to receive data. The BCD data will be lost and the 97S interface will turn off.

The 4 bit BCD digit values are the same as listed in the 97S Interface User Manual.

HEX	Decimal	Function
0	0	Digit 0
1	1	Digit 1
2	2	Digit 2
3	3	Digit 3
4	4	Digit 4
5	5	Digit 5
6	6	Digit 6
7	7	Digit 7
8	8	Digit 8
9	9	Digit 9
A	10	Decimal Point
B	11	EEX
C	12	ENTER
D	13	Run from [A]
E	14	Change Sign
F	15	NOP

The BCD digit transfer can be terminated by a NOP if < 10 BCD digits are to be sent, otherwise the 97S will standby expecting more data and will timeout after a second or so and the BCD digit transfer will terminate.

BCD Transfer Example:

The interface is set up to read a set of weight scales.

Weight = 34.27Kg

Request the Status Register to see the state of the Ready Flag.

Ready Flag = 1

Send digits

Run program [A] to process the data and reset Flag F3

Send cmdReqStatus	\$F0
Return	Status register
Bit 4 Ready = 1	(97 is ready to receive BCD digits)
Send [cmdSendDigits]	\$F1
Returns	\$F1 – OK to receive a BCD digit (Ready Flag cleared)
Send	\$3
Returns	\$F1 – OK to receive a BCD digit
Send	\$4
Returns	\$F1 – OK to receive a BCD digit
Send	\$A (DP)
Returns	\$F1 – OK to receive a BCD digit
Send	\$2
Returns	\$F1 – OK to receive a BCD digit
Send	\$7
Returns	\$F1 – OK to receive a BCD digit
Send	\$F (NOP)
Returns	\$A0 - Digit data is accepted
	The data will be processed and once complete the Ready Flag will be set = 1.

The received BCD digits are stored in a 10 digit buffer and when all have been sent for the particular transfer they will be sent to the PIK key buffer one at a time whenever it is empty.

It is done this way because the PIK key buffer only holds 7 keys and it could overflow and ignore some of the incoming digits.

Once BCD digits are expected, the 97S will only wait for about 1 second to receive them. If a timeout occurs, \$A2 will be sent to the interface and the 97S mode will turn off.

If more than 10 digits are sent to the 97 before a NOP is received, the transfer will terminate and the BCD digits will be lost. \$A1 will be returned and the ready flag will be set to 1.

When the [A] program runs, the HP microcode will clear Flag 3. As soon as Flag 3 is cleared, the Status Register will be sent to the interface with the `FlagChanged` bit set to 1 and the new state of the flag bits. The Ready flag will be clear (not ready) because a program is running.

The digits can be entered in any order, but because the Run From [A] digit will start a program running, all subsequent digits will be ignored because the Ready flag will have been cleared.

Errors are shown on the 97 display for buffer overrun and for receive errors and data timeouts.

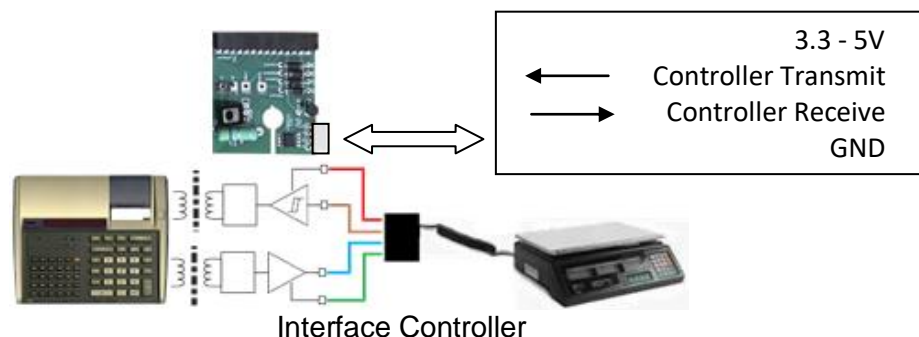
Connection

Connection to the 97S is via a 4 pin socket at the top rear of the board. A 4 pin IDC strip can be used to plug into this socket with a 4 strand ribbon cable soldered to it which is then connected to the interface module. The length of this cable will depend on its capacitance and external electrical interference and how these affect the serial port signal. Generally speaking, the shorter the cable the better it will work. A 300mm length would be a good start. It may well work with longer lengths and these can be tried, but if errors start to be introduced, then it needs to be shortened or a better quality and perhaps shielded cable may be required.

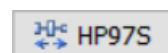


Thin ribbon cable is preferred as it can exit in between the calculator case join and the calculator will not require modification. Round cable will need some sort of modification to the casing, however this was the original cable type used for the HP-97S.

The serial port is electrically isolated from the HP-97 and therefore the connection requires a separate 3.3 - 5 volt power supply.



The CalCom program has an inbuilt utility that works as a dummy interface controller. For this to work, the 97S mode should be enabled. When CalCom is connected to the HP-97 board, this button will appear. Click it to open the interface.



On/Off	Turns the interface on or off
Read Status	Sends cmdReqStatus to the interface
Send Digits	Sends cmdSendDigits to the interface
Clear	Clears the message window
Digits	Enter the digits to send to the 97S

Example: Turn the interface on, enter digits, press [Send Digits].

Data flow is displayed in the message window.

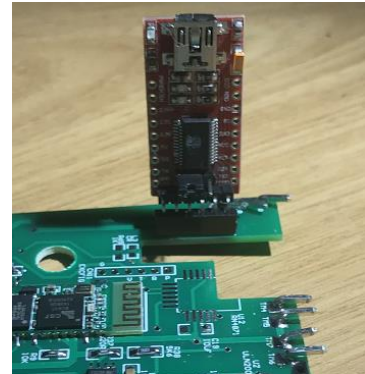
The interface will ask for the Status Register to test for a ready state before sending the digit data.

PC Communications and Software Re-Flash

PC communications can be accomplished by using the inbuilt Bluetooth or via a USB / FTDI module. These systems work in exactly the same manner as in the other CPU boards. The only difference is where the FTDI module plugs in to the 97 board. More Re-Flash details can be found [here](#). The LED near the clock battery will stay on constantly while either the USB or PICKit3 items are connected.

Note: Unplug the print head connector and disconnect the battery and CPU board from the calculator when FTDI PC communications or re-flashing is required.

Use the [prise](#) method described previously. All other wires can stay connected. Any non-conductive utensil, (like a biro), can be used to hold the CPU board separated from the keyboard pins.



Reprogramming

The reprogramming procedure for the HP-97 is exactly the same as the other CPU boards and the diagram at right shows where the PICKit3 module plugs in. Make sure the [M] pin on the PCB lines up with the arrow on the PICKit3.

Usually the USB cable to the PICKit3 will hold the PICKit3 in place during the re-flash process, if not light finger pressure pushing forward or reverse to hold the pins tight in the PCB holes should suffice.

The PIC program data file for the HP-97 CPU board will be in the form: HPF9702.hex

02 represents the software version. The software will choose the highest version number available.



The HP-97 FTDI re-flash has a fast mode and can be selected when the procedure begins. This mode can shorten the programming process considerably as it will only reprogram parts of the memory that have changed in the new data file. If you choose not to use this option, the CPU will be re-flashed in the normal way.

If the re-flash process fails or is interrupted, the 97 CPU board will power up in re-flash only mode and the board will not function as a calculator until it has been re-flashed properly. The fast re-flash mode is not available in this case.

For the fast re-flash mode to work, the current version PIC hex file needs to be available in the CalCom install directory. For example, if the software version in the calculator CPU is 01, then HPF9701.hex should be available. This file should normally be in the install directory unless it was deleted. Any updated files should be downloaded from teenix.org and stored here as well.

Note: As with the other boards, Bluetooth is not available for the re-flash process.