

H8000 IN-CIRCUIT FLASH
MICRO-CONTROLLER PROGRAMMER
FOR H8 & H8S MICROCONTROLLERS

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TecSys GmbH
Karl Theodor Str. 55
80803 München
Tel.: +49 (0) 89 321 990 – 0
Fax: +49 (0) 89 307 21 65
email: sales@tecsys.de
Internet: <http://www.tecsys.de>

LLOYD RESEARCH LTD.,
7/7A BROOK LANE, WARSASH,
SOUTHAMPTON, HANTS., UK, SO31 9FH.
Tel: +44 (0) 1489 885515/574040
Fax: +44 (0) 1489 885853
Internet: <http://www.lloyd-research.com>
E-mail: progs@lloydres.co.uk

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1. INTRODUCTION

The H8000 has been designed for production-programming modern H8 flash-based microcontrollers on assembled printed-circuit-boards (pcbs). It can support H8s and H8Ss with Vcc supplies in the range 1.8V to 5V. It also supports H8s with a second Vcc supply used to drive peripherals. It cannot support old flash H8s which require a separate Vpp supply.

It is much easier to use in a production environment than a development programmer as no PC is needed. It is also, in most cases, much faster because there is no time wasted in communications with a PC and non-standard baud rates can be used over the RS232/UPB connection.

The H8000 uses the same programming interface as the Renesas (previously Hitachi) development-system, namely the RS232/UPB as well as the faster E10 interface. If, therefore, a product is developed using the Renesas programmer, it should be possible to program it with the H8000.

A copy of this manual can be found as a help file on the CDROM containing the utility program. However, the user can change the help file to suit the application. In case the help file is accidentally deleted, a second copy is provided on the CDROM under the name 'H8000 programmer.txt'.

2. HOW IT WORKS

The H8000 is contained in a box about the size of a large matchbox. It is small enough to fit inside a test jig or ATE system, or it can be 'hand-held'. It is powered from a universal wall adaptor (supplied) or a 9V DC 400 ma supply. Before using the programmer, it must be 'set up' using any PC. A PC utility-program is supplied for this purpose but it is also possible to use Microsoft's HyperTerminal program which is supplied as standard on most PCs. Other terminal emulation programs such as PROCOMM can also be used. Connection to a PC's RS232 COM port can be made with the 9 way cable supplied. The 'set up' procedure transfers the programming algorithm to the H8000 from a PC and allows the user to enter certain parameters which are checked before programming.

The data to be programmed into the target H8 must be programmed into a 32 pin EPROM which can then be fitted in the rear of the H8000 programmer. Pin 1 is indicated by a '1' on the pcb. (If you are looking at the rear of the programmer and the EPROM is on the left-hand side, then pin 1 is in the top left-hand corner.) **IT IS ESSENTIAL THAT THE H8000 IS TURNED OFF WHEN FITTING AN EPROM.** Apart from electrical considerations, the H8000 calculates the checksum and CRC after power up.

The H8000 needs to be connected to the target by the 14 way (20 way in the case of the 3048BF) ribbon cable supplied. Please note that a 14 way and 20 way cable are supplied with each programmer.

Programming can be started either by pressing the PROGRAM button, or by using a logic signal or by simply connecting the programming ribbon cable. An RS232 command can also be used.

The target system must be powered up independently of the H8000. The H8000 will, however, check that the Vcc is within specified limits at the 'set up' stage.

Programming is essentially a PASS/FAIL process. During programming, an orange 'Busy' LED is lit and, on successful completion, a green 'Pass' LED comes on. If the device fails to program, 'fault' or 'fail' LEDs are lit as appropriate. At the 'set up' stage, the user can also specify a checksum and/or a CRC check.

Note that H8/H8Ss are automatically erased when entering programming mode. It is, therefore, not possible to verify devices after post-programming power-down or to read devices. In this respect, the serial programming algorithms used by the H8000 differ from conventional parallel programming methods as used by most standard programmers.

At power up (assuming that no target is connected), the H8000 will perform a 'self test' which includes testing the pin drivers and that all the LEDs can be lit. If all tests are passed, no target is connected AND a data EPROM is fitted, the LEDs will turn off and the programmer will now be ready for use. If a valid algorithm is loaded, the LED by the appropriate socket will turn on. If the programmer has been set up, programming can start immediately. If any test fails, an EPROM is not fitted or a target is connected, the fault LED will be lit and programming will not be able to commence. To diagnose faults, connect the H8000 to the H8000 PC utility program or Hyper Terminal, since the H8000 can diagnose most faults if the processor is running. The 'self test' can be repeated by sending the command 'ST' followed by 'RETURN' to the RS232 port.

3. CHECKLIST OF INFORMATION/FACILITIES NEEDED

This section explains the information and facilities required to program a target H8/H8S.

1. The target board must have an appropriate interface to connect the H8000. The fastest port is the E10, but even the UPB/RS232 port can work at speeds of up to 300.000 baud because the H8000 can use non-standard speeds.
2. The correct algorithm for the target must be used. Note that the algorithm has to be for the target clock-speed and the chosen port. Algorithms are available from Lloyd Research or their distributors for a nominal cost. Each algorithm is licensed for use on a particular programmer. When requesting new algorithms, please quote the clock speed of the target system as different algorithms are required for different clock speeds. Note that algorithms which are not licensed may be used ten times for evaluation. A further ten devices can be programmed by reloading the algorithm. The serial number of programmers allowed to use each algorithm is contained within the algorithm file. Therefore, if you have more than one programmer, you will need a license for each H8000.
3. A suitable ribbon cable terminated with a 14 way IDC header must be used. (Note that the 3048BF needs a 20 way cable.) Both cables are supplied as standard.
4. A 'Windows' PC is required to set up the programmer. The 'set up' procedure is explained in more detail later in the manual. Either HyperTerminal or the H8000 PC utility program is also required.
5. An RS232 cable with a 9 way plug at one end and a socket at the other is needed to connect the RS232 ports of the PC and the H8000. A suitable lead is supplied as standard.
6. The operating voltage limits are required for Vcc of the target. For example, a board with a 5V processor is probably designed to run from 4.5V to 5.5V. These limits will be needed at the 'set up' stage.
7. The code to be programmed into the target H8 should be programmed into a 32 pin DIL EPROM with an access speed of 100nS or faster. Typical EPROMs would be 27C010, 27C020, 27C040, 27C080 or 27C801.
8. The H8000 verifies each block after programming. However, it is possible to specify at the 'set up' stage whether or not to calculate and check the checksum and/or CRC after programming. The post-programming checks add to the total cycle time.
9. A decision needs to be made as to which method is to be used to start programming. The choices are to start programming a nominal 100mS after the target is connected or when either a logic signal is received or when the PROGRAM button is pressed. At the 'set up' stage, the user can specify that programming is to start on connection. Finally, it is possible to start programming by sending the command 'PR' followed by 'RETURN' over the RS232 interface.
10. An H8000 programmer must be connected to a wall-adaptor or an external 9V 400 mA supply terminated in a 2.1 mm jack with the positive supply at the tip.

4. HOW TO SET UP THE PROGRAMMER

HyperTerminal or any other terminal emulator program such as PROCOMM can be used to set up the H8000 programmer. Details such as the algorithm to be used and various limits are held in the H8000. Therefore, when changing from one target H8/H8S processor to another, the programmer must be set up on a PC. However, if the data is just being changed, the H8000 does not need to be set up UNLESS the 'set up' indicates that the processor must be checked for a specific checksum.

It is also possible to use the H8000 PC utility program supplied. The main difference is that it is easier to change algorithms using the utility program. Use 'SETUP.EXE' to install the utility program which is written in Visual Basic. When the program is first run, click on 'CommPort' and then 'Properties' to select a free Comm Port. Note that the baud rate, etc., is fixed. Having selected the Comm Port, click on 'Port Open'. The port status is then shown at the bottom of the screen and the H8000 will display the current status. The H8000 programmer should always be powered up and connected to the PC before the H8000 PC utility is started.

For full details of Hyper Terminal, please refer to Microsoft documentation.

Hyper Terminal can be found by clicking on 'Programs', selecting 'Accessories', then 'Communications' and, finally, by clicking on 'Hyper Terminal'. The exact method of operation is different for various versions of Windows.

WINDOWS ASKS: Enter a name and choose an icon for the connection.

Enter name H8000 (or anything else), then select an icon.

WINDOWS ASKS: Enter details of phone number you want to dial

Instead of entering a phone number, go to the dialogue box 'Connect using'. It will probably show a modem. However, select an RS232 COM port such as COM1 or COM2 instead.

WINDOWS ASKS: Port settings

Enter details as follows:

Bits per seconds: 19,200

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

Assuming that the H8000 is connected to the PC's specified COM port, there should now be a working connection. If there is not, click on the telephone icon to disconnect and then click on the icon to connect again. If the H8000 is now turned on, the 'sign on' message should be displayed. If, however, alternate lines are blank, it is likely that Hyper Terminal is appending a line feed after each line. This 'appending' can be removed as follows:-

Click on 'File', then click on 'Properties'.

Select 'Settings' and click on 'Ascii setup'.

Make sure the box 'Append line feeds to incoming line ends' is not checked. If it is, click on it so that the box is clear.

Close the dialogue boxes to get back to the main screen.

The next time Hyper Terminal is used, it should be possible to click on the icon you chose the first time. The new connection screen may have to be closed before clicking on 'File', then 'Open', etc.

Whether or not Hyper Terminal or the H8000 PC Utility has been installed, it should now be possible to set up the H8000. For a full list of commands, type 'HE' for help followed by 'RETURN'. By typing 'SC' for show configuration, a screen similar to the following will be produced:

[100] *****
[101] ** MODEL H8000 - FLASH PROGRAMMER FOR H8 MICRO CONTROLLERS **
[102] *****
[103] (c) Lloyd Research Ltd. 2003
[104] Serial no : 0013
[105] Firmware version no : 1.1
[106] For updates and product info see www.lloyd-research.com

ALGORITHM INFORMATION

Target processor H8/3664
Algorithm name H83664__UPB_____16000_____1
Comms method to target Asynchronous
Connector UPB-RS232
Nominal processor clock speed in KHz 16000 KHz
Algorithm version number 1
Licensed for this programmer Yes

USER CONFIGURATION

PARAMETER EXAMPLE CURRENT
COMMAND VALUE
Maximum target VCC supply (limit 5.5) TU 5.5 5.5
Minimum target VCC supply (limit 3.3) TL 3.3 3.5
Communications speed to target % of maximum
(max 100) CT 100 100
Actual target processor clock speed in KHz
(15520 - 16480) TC 16000 16000
Start programming after connection (Y / N) AS YN

VERIFICATION SECTION

First address = hex 00000000, last address = 00007FFF
PARAMETER EXAMPLE CURRENT
COMMAND VALUE
Currently expected checksum is CS 12341234
Currently expected CRC is CR BB05BB05
Verify checksum after programming (Y / N) VS YN
Verify CRC after programming (Y / N) VC YN

To change any value type command then SPACE then new parameter then press RETURN.
For a full list of commands type HE then press RETURN

[127] Starting self test...
[540] WARNING! EPROM Checksum has changed!
EPROM checksum has changed to 0000BF04
But expected value is 00001234
[129] Self test passed but EPROM checksum has changed
[109] +>

PLEASE NOTE: The above layout has been edited so that the printing fits on a single line.

The configuration section has three parts.

The first part defines the algorithm used. H8000s are usually shipped with an algorithm for H8/3664 as the target processor. The algorithm name is usually the same as the file name. The Comms method is the method of connecting the H8000 to the target and is usually determined at the design stage.

UPB uses the H8's RS232 port but E10 is usually faster.

Note that the H8000 has two different connectors depending on whether the Comms method is UPB or E10. An LED is lit by the relevant connector.

DO NOT USE THE WRONG CONNECTOR!

The H8/H8S processor clock speed is the crystal or oscillator frequency to clock the target processor in Khz. Some examples are:-

Oscillator frequency	Clock speed in KHz
1 MHz	1.000
5 MHz	5.000
10 MHz	10.000
20 MHz	20.000

The oscillator frequency needs to be correct to within about 3%. This tolerance ensures correct timing for the programming pulse and reliable communications over the UPB/ RS232 port where used. For example, if the nominal oscillator frequency is 16 MHz, the lower limit is 15.520 KHz and the upper limit 16.480 KHz. Finally, the H8000 shows whether a licence has been purchased for the algorithm. There are two alternatives:-

'Yes' - where the user can program an unlimited number of devices

'No, but you can program 10 devices for evaluation' - where only 10 H8s can be programmed before the licence expires. This allows the user to test the algorithm before purchasing a copy for production. The algorithm can be downloaded to the H8000 a second time and a further ten devices can be programmed.

Each algorithm is encrypted with the serial numbers of programmers allowed to use it. Therefore, if you purchase an algorithm, it is important to make sure you have the latest copy which should then allow you to use it without needing to reload it every ten times! When ordering a new algorithm, be sure to quote the serial number shown.

The next section contains certain parameters unique to the application.

The first two parameters define the maximum and minimum Vcc. The H8000 measures the Vcc and uses this measurement to define the logic levels for output and input signals. If an attempt is made to program a device with Vcc outside these limits, the 'FAIL' LED will be lit and the operation will not be attempted. Some processors have a second (peripheral) Vcc which must also be defined.

The 'Communications speed to target, % of maximum' allows the user to slow down the communications over the RS232 port to the target. This may be desirable in cases where the lead length between the H8000 and the target is more than 30 cms or if electrical noise is present. The default setting is 100 which equates to no reduction.

Finally, click on 'Send' to send the file to the H8000. Once the new algorithm has been loaded, the H8000 will display the current configuration.

If a new algorithm is required and the utility program is being used, read this section:

Click on the icon on the tool bar to load new algorithm. Then select the appropriate algorithm using the 'Open' command. The new algorithm will be downloaded automatically. Then the H8000 will show the current configuration.

A list of commands can be displayed by typing 'HE' for help.

The current configuration can be shown by typing 'SC'. Note that all commands need to be followed by 'RETURN'.

The data to be programmed into the H8 must be programmed into almost any 32 pin EPROM. The EPROM must be fitted into the eject socket. Access to this socket is by unscrewing the compartment at the rear of the programmer. Be sure to fit the EPROM the correct way round otherwise it may be destroyed and the internal fuse in the programmer may need replacing. The '1' on the pcb should be opposite pin 1.

BE SURE TO TURN OFF THE POWER TO THE H8000 WHEN CHANGING EPROMS.

5. THE ATE AND USER INTERFACE INCLUDING DATA LOGGING

These are described in one section because the functions and signals are very similar.

The ATE logic signals are optically isolated. The controller needs to supply a reference Vcc between 3V and 5V DC and a logic GND. All output signals are active low. This GND is optically isolated from both programming GND and RS232 GND which are connected.

The programmer can be started in one of four ways:

1. manually by pressing the 'PROGRAM' button;
2. automatically by connection to a target;
3. by pulling a logic signal low over the ATE interface; or
4. by issuing the command 'PR' over the RS232 interface.

There are four output signals from the H8000. When asserted, the relevant LED is lit and the ATE logic signal goes low assuming that the reference Vcc and GND have been connected.

The signals are:

FAULT Indicates a fault such as a failure to connect to a target.

BUSY Indicates the programmer is busy - typically programming/working out the checksum or CRC.

PASS Indicates the last programming attempt was a success.

FAIL Indicates the last programming attempt failed.

The Controller connections are:

1. GND
2. /Fault
3. /Busy
4. /Start
5. Not used
6. VCC - 3V to 5V to be supplied by the controller
7. GND
8. /Pass
9. /Fail
10. GND

It is essential that 3V or 5V is applied to pin 6 with GND on one of the ground pins. Without this voltage, the H8000 cannot supply any logic signals.

Data can be logged in several ways:

All messages output from the H8000 can simply be stored as text.

All important messages can be prefixed with a number such as [135] and the number can be monitored and actioned as required.

After failed commands, the prompt for the next command is ->, whilst it is +> after successful commands and this could be executed.

The RS232 interface can be used to control the programmer and/or for data logging. The port parameters are fixed at 19.200, 8 data bits, no parity and 1 stop bit. After every H8 is programmed, a message is output:

[135] Programmed OK (Checksum=1234)

where 1234 is the checksum.

Note that the first five characters of each important message take the form [xxx] where xxx is a number. An ATE system just needs to check the number.

6. APPENDIX 1 - RS232/UPB CONNECTIONS

The connection should be made between the target with a 14 way ribbon cable. The connections are as follows:-

PIN NO.	SIGNAL NAME	DIRECTION		COMMENT
		H8000	TARGET	
1	Target Vcc	<		Measured and checked
2	Ground			
3	Transmit	>		
4	Receive	>		
5	Clock	>		Connected to Pin 9
6	No connection			
7	No connection			
8	No connection			
9	Clock	>		Connected to Pin 5
10	Target reset			
11	Flash write enable	>		FWE
12	Mode Pin 1	>		
13	Ground			
14	Target connected?	<		Grounded when true

7. APPENDIX 2 - E10T CONNECTION

The connection should be made between the target with a 14 way ribbon cable. The connections are as follows:-

PIN NO.	SIGNAL NAME	DIRECTION		COMMENT
		H8000	TARGET	
1	Clock	>		
2	Ground			
3	Flash write enable	>		FWE
4	Mode Pin 0	>		
5	Receive	<		
6	Mode Pin 1	>		
7	Target NMI	<		
8	Target Vcc	<		Measured and checked
9	Peripheral Vcc	<		Measured and checked
10	Mode Pin 2	>		
11	Transmit	>		
12	Mode Pin 3	>		
13	Target reset	>		
14	Target connected?	<		Grounded when true

8. APPENDIX 3 - E10/3048BF CONNECTIONS

The connection should be made between the target with a 20 way ribbon cable.
The connections are as follows:-

PIN NO.	SIGNAL NAME	DIRECTION		COMMENT
		H8000	TARGET	
1	Target reset		>	
2	Ground			
3	Flash write enable		>	FWE
4	Ground			
5	Mode Pin 0		>	
6	Ground			
7	Mode Pin 1		>	
8	Ground			
9	Mode Pin 2		>	
10	Ground			
12	Ground			
14	Target connected?		<	Grounded when true
15	Receive		<	
17	Transmit		>	
18	Target Vcc		<	Measured and checked
19	Clock		>	
20	Target Vcc		<	Measured and checked

9. SERVICING AND MAINTENANCE

The H8000 can be dismantled for servicing by removing two screws which are visible when the cover is taken off of the EPROM compartment and a further two screws at the other end of the case near the serial number label.

There are no user adjustments and no routine calibration is needed.

If the EPROM has been changed very often, the socket may need replacing. Since the EPROM socket is a push fit into a turned pin socket, it can easily be replaced. It is available from various distributors such as RS Components under part number 117-9107 or Farnell under part number 178-947.

The programmer is fitted with a 20 mm long 500 mA fuse. This may blow if an EPROM is fitted the wrong way round.

The line drivers are protected against shorts to any voltage between 0V and 5V by 330R resistors. Most of the resistor elements are contained in a plug-in resistor network contained in a 16 pin DIL package. This resistor network also acts a series terminator. Depending on the cable length used, it might be beneficial to change the value. However, any value under 330R will reduce the protection and may result in a driver IC failing under fault conditions.