Connecting the Nohau EMUL51-PC Emulator to the PHYTEC phyCORE-591 Rapid Development Kit.

Application Note # 200 *Version 1.0*

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Background

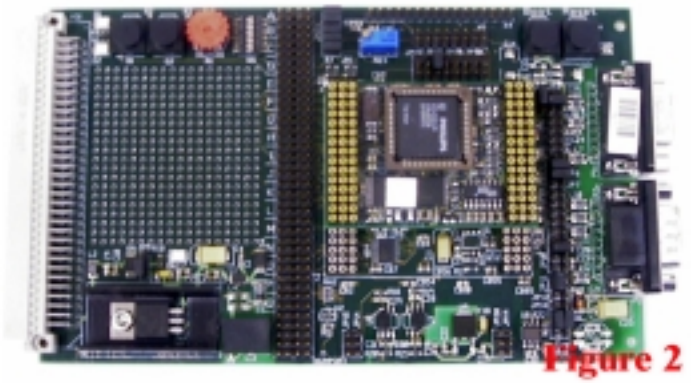
This application note is designed to help connect the Nohau EMUL51-PC emulator to the PHYTEC phyCORE-591 Rapid Development Kit. It is assumed you have a working knowledge of the emulator. See the EMUL-51 Getting Started Manual for more information.

The Emulator

Nohau manufactures real-time in-circuit emulators offering complete support for the Philips C591 microcontroller family. Controllers currently supported are the P80C591 (ROMLESS) , P83C591 (ROM) and P87C591 (OTP). The emulator consists of a High Speed Parallel (HSP) box, that contains an emulator board and optional trace board. The P8xC591 pod connects to the HSP box with a ribbon cable. Communication to the PC is via the LPT port or an ISA card. The user interface, Seehau, is a powerful debugging tool designed to run user code either stand-alone or connected to a user target system. The emulator is a standalone device and is shown in Figure 1. The emulator can run in single-chip or expanded mode using the Philips "hooks" mode emulation technique. See www.nohau.com for more information or contact your local Nohau representative.

The PHYTEC Rapid Development Kit

The PHYTEC Rapid Development Kit as distributed by Philips consists of a small phyCore-591 single board computer module attached to a development board. This system is pictured in Figure 2 showing the small single board computer with the P8xC591 microcontroller installed in a PLCC 44 pin socket. This system can be run stand-alone as pictured in Fig.2 or with the emulator connected, as shown in Fig. 4 to offer greater debugging and testing This is accomplished by removing the C591 controller and plugging the emulator into the PLCC socket. The user then has complete control and access to the target system resources. You can contact PHYTEC at www.phytec.com. USA phone is (206) 780-9047 and Germany is +49 6131 9221-0.



The Adapter

To connect to the PHYTEC board a standard PGA to 44 pin PLCC adapter is used. The Nohau part number is PGA44-PLCC44. This is an industry standard adapter. Call Nohau Technical Support for ordering information. Figure 3 shows the bottom of the emulator with the adapter Pin 1 Notch clearly shown by the arrow.

Memory Organization of the phyCORE-591

The Philips 8051 family uses separate code and data memory areas. This is called the Harvard Architecture. The emulator has a total of either 256 or 768K of emulation RAM depending on the model. This memory may be used to replace memory that normally resides in the target. This emulation memory can be allocated to the code and/or data space in several configurations.

This note uses a 256K emulator with 64K mapped to the code space and 64K mapped to the data space. This is set in the Seehau software under the Config, emulator menu item and is the default configuration. The C591 has a 64K address space for code and 64K for data. The additional memory is available for bank switched aapplications.

The emulator provides a mechanism to map the code or data memory areas either to this emulator RAM or to the memory devices on the target board. For example, you can use the RAM in the emulator to replace the FLASH in the target allowing easy and fast code loading without reprogramming the FLASH device. The target ROM or RAM can be mapped to the emulator with a granularity of 4K bytes.

FLASH Memory:

There is one FLASH device U8 which is a 29F010 128K byte by 8 bits device which represents 128K bytes of FLASH memory. The 80C591 can only address 64K of CODE, therefore this provides 2 banks of 64k each. The address range is from 0 to 1FFFF hex. The upper 32K byte, of bank 0 (8000 to FFFF hex), is reserved for the PHYTEC FlashTools firmware.

The emulator can run programs from either the FLASH devices or in the code emulation memory.

RAM Memory:

There is one RAM device U9. This is a 128K by 8 bit device for a total of 128 Kbytes. The address range is from 0 to 1FFFF hex. The emulator can access this RAM or the emulation RAM for data storage.

The Bootstrap Loader

In conjunction with "RESET" button (S4), the "BOOT" button (S3) on the phyCORE development board enables the PHYTEC bootstrap loader function. The C591 does not have its own bootstrap loader, this is a PHYTEC implementation of their own and is described in their Hardware Manual.

In the PHYTEC directions, the bootstrap mode is entered by holding the RESET and BOOT buttons down together, releasing the RESET, then a few seconds later, the BOOT button.

With the emulator connected, the procedure is slightly different. The bootstrap mode is entered by ensuring the emulator is in the stop mode; it will say STOPPED in the bottom left hand corner. This is the emulator monitor mode. The Code and Data memory areas must be mapped to the target and is described later.

Hold the RESET and BOOT buttons down together and release the RESET. Still holding the BOOT down, press the RESET icon on the emulator and then press the GO icon. Release the BOOT button and the emulator will run the PHYTEC bootstrap mode firmware in the FLASH.

It is necessary to press the PHYTEC RESET button down in addition to the emulator RESET icon because the PHYTEC CPLD logic chip must be reset: the emulator does not send its RESET signal down to the board to avoid RESET line contentions. You can send the PHYTEC RESET up to the emulator by adding the RESET jumper JP5

You still need to activate both RESET lines when JP5 is jumpered and the emulator is stopped (it is in *monitor mode*). This in order to reset the PHYTEC CPLD device. But pressing the PHYTEC RESET button will reset both the board and the emulator and execution will continue as before with JP5 jumpered.

Powering the PHYTEC phyCORE-591 Board

The PHYTEC board needs be powered by its own power supply via the 5 volt regulator U1 on the development board. Remember to power the emulator first and the target second. You do not want the target to have power when the emulator does not.

Shut down Seehau and remove the power before connecting or disconnecting the target with the emulator. You can remove or add most jumpers on the emulator or the target while the system is powered but not running in emulation mode. Click on the RESET icon in Seehau to activate any new jumper settings. Reload the example program if you changed any address jumpers.

Connecting the Emulator to the phyCORE-591 Board

It is a good idea to get the emulator working in stand-alone mode without being connected to the target system. This way ou are sure your system is operational and you will be able to better isolate any problems potentially encountered.

See the Nohau 51 Getting Started Manual for examples and hints on getting your system operational quickly.

The examples given in this note will be running the PHYTEC FlashTools utility via the emulator to check, erase and program the FLASH device. A simple example program will be loaded and run which will blink led LED D1 on the board at a rate of once per second.

Setting the Emulator Jumpers

The jumpers must be set as shown. The default settings are marked *(DEFAULT)*, and the settings specifically for the phyCORE-591 board *are marked (phyCORE)*.

The JP4 jumpers labeled M1 and M2 are used to select single chip (internal ROM), or expanded mode (external CODE and XDATA), and if P0,P3.6 and P3.7 are general purpose I/O,.

Single Chip			
(DEFAULT)	M1	on	CODE
(DEFAULT)	M2	on	XData
Expanded Mode			
(phyCORE)	M1	off	CODE
(phyCORE)	M2	off	XData
Internal Code, XData Mode			
	M1	on	CODE
	M2	off	XData

Processor Power			
(DEFAULT)	XJP2	INT	From pod
	XPJ2	EXT	From target
Reset			
(DEFAULT)	JP5	on	RESET from target
Clock			
(DEFAULT)	JP6 & 7	I	Internal clock
		E	Target clock

Clock Circuit: Emulator or Target ?

There are two jumpers beside the crystal on the emulator (JP6 and JP7). Connect the clock XTAL1 and XTAL2 (JP6 and JP6) to the E (external) position to use the phyCORE crystal. To select the emulator oscillator clock connect JP6 and JP7 to the I (internal) position. Problems starting up the emulator may happen because the crystal signal is not strong enough due to the extra lead length. In this case connect the two jumpers to the I position and use the emulator oscillator.

Connecting the Emulator and Powering Up

Connect the emulator as shown in Figure 4. Power the emulator first, then the target. Start Seehau from your PC. If the emulator does not start, check all connections and jumper settings. During the configuration process select C591. Use the defaults for all other settings. Try starting the emulator stand alone without being connected to the target or try switching the XTAL jumpers JP1 and JP2 to POD. Make sure the ground wire is connected to the right hand end connector of header X2.

The photo in Figure 4 shows several black PGA extender adapters between the emulator and the PLCC plug. This was done for clarity. In practice all the extenders should be removed to improve high frequency operation. It is important to have all leads as short as possible, especially the clock signals, in adherence to good engineering practice.

In the Seehau Source Window you should see something like the following if an example program is loaded in FLASH:

```
000000  026023          LJMP 6023
000003  FF              MOV R7,A
...                ...              ...
```

If the PHYTEC FLASH is blank, you will get FF. If good code comes up, the emulator is running: congratulations! - you have successfully got the system to work.

Some Helpful Notes and Reminders

1) The M2 jumper is important. It must be off to access Xdata on the target. The LED D1 will not blink if this jumper is set wrong.
2) The Xdata must be mapped to Target for the LED D1 to work.
3) Adapter - take out as many of the connector layers as possible on the adapter - make the path to the target as short as possible.
4) The PHYTEC RESET comes up to the emulator but RESET from the emulator does **not** go down to target. This means that if you perform an Emulator Reset you will have to reset the target with the RESET button to reset the PHYTEC CPLD.
5) Using the crystal on the target to supply CLK to the bondout is more unreliable than the emulator oscillator due to the extra lead length. The emulator oscillator provides a more stable signal.
6) Make sure the ground clip is connected to the target as shown in Figure 4.

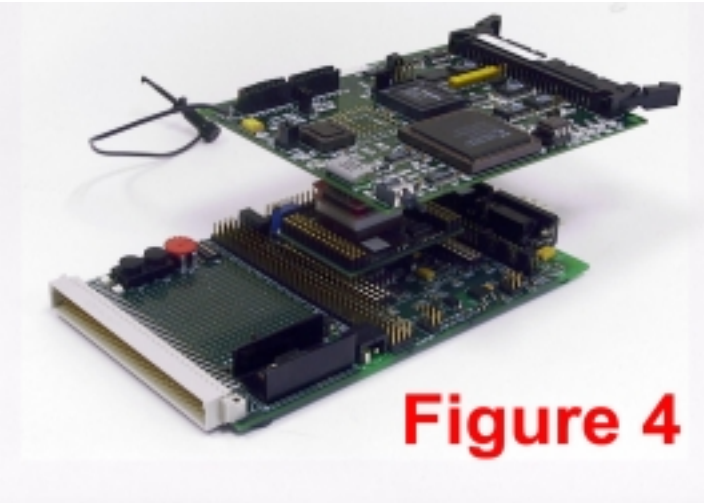


Figure 4

Configuring the Memory Mapping

1) Select Config Emulator in the Seehau software:
2) Click on the memory map config tab - the memory config tab

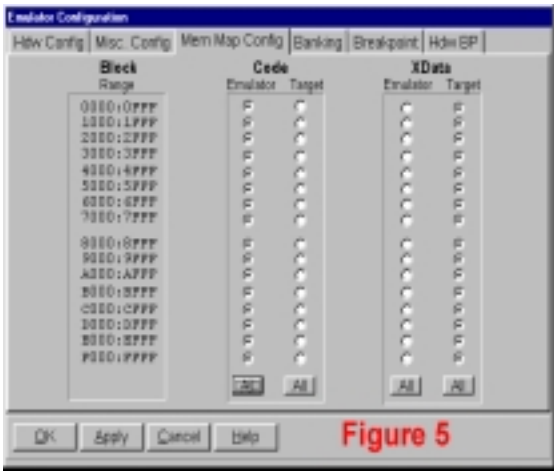


Figure 5

is displayed below:

3) Then click the All button under XData-Target.

   This maps the target XData memory into the emulator. When the emulator accesses this memory space, it will access the target's memory.
4) Note with this setting your program will run using the emulation RAM for code rather than the PHYTEC FLASH. The XData memory must be mapped to the target in order for the LEDs to work.
5) Click OK to download your mapping information to the emulator. It will take a bit of time to download to the FPGAs. This maps all the EMUL-51 address space. If you make the ranges smaller, it will take less time to map.

Save These Settings !

In the main Seehau screen: select Config - Save Settings - click on Yes to save your settings.

This way, if a problem occurs and Seehau exits: you will not have to re enter all those address values.

I selected the macro file startup.bas to save the settings in but you can select any or name your own and call it any way you want using Seehau's settings.

Running an example program from emulation RAM:

Same set up as before but with no mapping of code memory space to the target. Please park this setting as described in **Configuring the Memory Mapping: 4)** above.

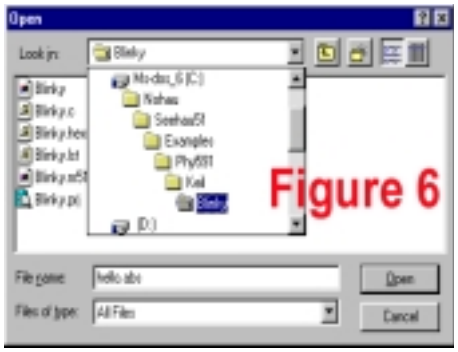
1) Select Config, Emulator and select all for code memory.

Note: The data memory must be mapped to the target or the LED and button signals will never reach the target. The demo program will look dead.

2) Click on OK - this will take a few seconds to remap the mapping memory arrays in the emulator.

Click on the emulator reset Icon and the target RESET button in any order.

4) In Seehau: File - load code. Browse to the directoy \examples\phy591\keil\blinky and load the file blinky, as shown in Fig. 5.



5) Next select File - verify loaded code: Should have no errors.

Note: Errors at this point are usually the result of trying to write to FLASH because the mapping is set incorrectly.

6) Press GO

Program will run: D1 should blink at a rate of once per second.

To prevent a crash, - hit the target reset button quick when you stop the emulator if you get the hour glass and you think it is not going to go away !

7) If you stop the emulator the C source code will appear in the source window. The trace window will display the last 131,000 instructions executed.

Getting FlashTools to work

You must select the code address mapping to access the target FLASH device. See Configuring the Memory Mapping

1) Click on the emulator RESET icon. Press and hold the Target RESET and BOOT buttons together. Click the Emulator RESET again.

2) Release the target RESET button (keep holding BOOT) and then click on GO on the emulator. The GO should change to STOP and stay this way. If it returns to GO- something is wrong, do it over again. Check your settings.

3) Release the BOOT button and the PHYTEC board will be in its bootstrap mode.

Note: Only the Emulator green light should be on, the red and orange emulator LEDs should not be lit.

4) Start FlashTools98.exe. and operate FlashTools as per the PHYTEC instructions.

5) REMEMBER - if the hourglass stays on for too long the emulator timeout may occur (especially when you stop the emulator program in some fashion) - press the Target RESET to prevent this if you sense this will happen !

3) You will be able to check, erase and program the FLASH memory on the PHYTEC board with the FlashTools utility.

Loading the Example Program into the Flash Memory

The emulator must map both code and data spaces to the target. See *Configuring the Memory Mapping* section for details.

1) Press and release the target RESET button. Click on the emulator RESET icon. The code shown on the previous page will show: AJMP 4021.

2) Press and hold the PHYTEC BOOT button and click on the emulator GO icon. The emulator should stay running.

3) Release the BOOT button and start the PHYTEC FlashTools utility. It will load normally.

4) Load the file blinky.hex from the same directory (Nohua->Examples->phyCORE->C591->Keil->Blinky.

5) Disconnect FlashTools via the Communications Setup tab in FlashTools.

6) Press the RESET button on the target.

7) Press reset then go in Seehau, the blinking program should run as before. You can start and stop execution. The trace memory can be viewed showing the last 131,071 instructions executed. Triggers can be set to many different qualifiers specified.

Conclusion

A simple demonstration has shown how easy it is to connect the EMUL-C591 to a target hardware and run a target application.