

phyCORE-P87C591

QuickStart Instructions

**Using PHYTEC FlashTools98 for Windows and the Tasking 8051
Embedded Development Environment (EDE)
Evaluation Version**

Note: The PHYTEC Spectrum CD includes the electronic version of
the phyCORE-P8xC591 English Hardware Manual

Hinweis: Die PHYTEC Spectrum CD beinhaltet die elektronische
Version des deutschen phyCORE-P8xC591 Hardware Manuals

Edition: July 2002

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phyCORE-P87C591 QuickStart Instructions

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1 Introduction to the Rapid Development Kit	1
1.1 Rapid Development Kit Documentation	1
1.2 Overview of this QuickStart Instruction.....	2
1.3 System Requirements	3
1.4 The PHYTEC phyCORE-P87C591	4
1.5 The Tasking 8051 Embedded Development Environment (EDE)	7
2 Getting Started	11
2.1 Installing Rapid Development Kit Software.....	11
2.2 Interfacing the phyCORE-P87C591 to a Host-PC	18
2.3 Starting PHYTEC FlashTools98 for Windows	20
2.4 Downloading Example Code with FlashTools	21
2.4.1 "Blinky"	26
2.4.2 "Hello"	28
2.4.3 CAN Demonstration Program	33
3 Getting More Involved.....	35
3.1 Starting the Tasking Tool Chain.....	35
3.2 Creating a New Project and Adding an Existing Source File.....	37
3.3 Modifying the Source Code.....	45
3.4 Saving the Modifications	46
3.5 Setting Tool Chain Options	46
3.6 Building the Project	49
3.7 Downloading the Output File	50
3.8 "Hello2"	51
3.8.1 Creating a New Project.....	51
3.8.2 Modifying the Example Source	52
3.8.3 Setting Tool Chain Options	52
3.8.4 Building the New Project	53
3.8.5 Downloading the Output File	53
3.8.6 Starting the Terminal Emulation Program.....	54

4 Debugging	55
4.1 Preparing the Target Hardware to Communicate with CrossView Pro.....	56
4.2 Creating a Debug Project and Preparing the Debugger	57
4.2.1 Creating a New Project	57
4.3 Setting Options for Target.....	58
4.4 Preparing the Debugger.....	64
4.5 Starting the Debugger.....	65
4.6 Tasking CrossView Pro Debug Features.....	66
4.7 Using the Tasking CrossView Pro Debug Features	68
4.7.1 Single Stepping and Watch Window.....	68
4.7.2 Breakpoints.....	71
4.7.3 Exiting CrossView Pro.....	73
4.8 Changing Target Settings for the "Final Version"	74
5 Advanced User Information.....	75
5.1 FlashTools98	75
5.2 Cstart.asm	77
5.3 Linking and Locating	78

Index of Figures

Figure 1: Mounting the phyCORE-P87C591 onto the phyCORE Development Board LD 5V	18
Figure 2: Important Connectors, Buttons and Suitable Jumper Settings on the phyCORE Development Board LD 5V	19
Figure 3: Power Connector	19
Figure 4: Memory Model for Use with the Tasking ROM Monitor (32 kByte RAM).....	59

1 Introduction to the Rapid Development Kit

This QuickStart provides:

- general information on the PHYTEC phyCORE-P87C591 Single Board Computer (SBC)
- an overview of the Tasking 8051 Embedded Development Environment (EDE) evaluation version, and
- instructions on how to run example programs on the phyCORE-P87C591, mounted on the PHYTEC phyCORE Development Board LD 5V, in conjunction with the Tasking EDE

Please refer to the [phyCORE-P8xC591 Hardware Manual](#) for specific information on such board-level features as [jumper configuration](#), [memory mapping](#) and [pin layout](#). Selecting the links on the electronic version of this document links to the applicable section of the phyCORE-P8xC591 Hardware Manual.

1.1 Rapid Development Kit Documentation

This “Rapid Development Kit” (RDK) includes the following electronic documentation on the enclosed “PHYTEC Spectrum CD-ROM”:

- the PHYTEC [phyCORE-P8xC591 Hardware Manual](#) and [phyCORE Development Board LD 5V Hardware Manual](#)
- controller [User's Manuals and Data Sheets](#)
- this QuickStart Instruction with general “Rapid Development Kit” description, software installation hints and four example programs enabling quick out-of-the box start-up of the phyCORE-P87C591 in conjunction with the Tasking software development tools

1.2 Overview of this QuickStart Instruction

This QuickStart Instruction gives a general “Rapid Development Kit” description, as well as software installation hints and four example programs enabling quick out-of-the box start-up of the phyCORE-P87C591 in conjunction with the Tasking 8051 software development tools. It is structured as follows:

- 1) The “*Getting Started*” section uses three example programs:
 - “*Blinky*” and “*Hello*” to demonstrate the download of user code to the Flash device using PHYTEC FlashTools98 for Windows.
 - An additional demo program demonstrates the CAN Self Receive Capability of the P87C591 microcontroller on the phyCORE-P87C591 module in conjunction with the phyCORE Development Board LD 5V.
- 2) The “*Getting More Involved*” section provides step-by-step instructions on how to modify both examples, create and build new projects and generate and download output files to the phyCORE-P87C591 using the Tasking tool chain and FlashTools98.
- 3) The “*Debugging*” section provides a fourth example program - “*Debug*” - to demonstrate monitoring of the board and simple debug functions using the Tasking 8051 EDE debug environment.

In addition to dedicated data for this Rapid Development Kit, this CD-ROM contains supplemental information on embedded microcontroller design and development.

1.3 System Requirements

Use of this “Rapid Development Kit” requires:

- the phyCORE-P87C591 SBC module
- the phyCORE Development Board LD 5V with the included DB-9 serial cable and AC adapter supplying 5 VDC/min. 500 mA
- the PHYTEC Spectrum CD
- an IBM-compatible host-PC (486 or higher running at least Windows95/98)

For more information and example updates, please refer to the following sources:

PHYTEC

<http://www.phytec.com> - or - <http://www.phytec.de>
support@phytec.com - or - support@phytec.de

 **TASKING**
Embedded software development from Altium™

<http://www.tasking.com>
tasking.support.na@altium.com (North America)
tasking.support.de@altium.com (Germany)

1.4 The PHYTEC phyCORE-P87C591

The phyCORE-P87C591 represents an affordable, yet highly functional Single Board Computer (SBC) solution in subminiature dimensions (40 x 55 mm). The standard board is populated with a Philips P87C591 controller, featuring a 6-channel on-chip A/D-converter with 10-bit resolution and an integrated CAN controller.

All applicable data/address lines and applicable signals extend from the underlying logic devices to standard-width (2.54 mm / 0.10 in.) pin headers lining the circuit board edges. This enables the phyCORE-P87C591 to be plugged like a “big chip” into target hardware.

The standard memory configuration of the phyCORE-P87C591 features 128 kByte external SRAM and 128 kByte external Flash for code storage (64 kByte for FlashTools firmware and 64 kByte for storage of user code). The Flash device allows direct on-board programming. Three Chip Select signals are available for external I/O connectivity.

The module communicates by means of an RS-232 transceiver and operates within a standard industrial range of 0 to +70 degrees C. It requires only a 250 mA power source.

PHYTEC FlashTools98 enables easy on-board download of user programs.

phyCORE-P87C591 Technical Highlights

- SBC in subminiature dimensions (40 x 55 mm) achieved through advanced SMD technology
- populated with an 44-pin packaged (PLCC) Philips 8051-compatible P87C591 controller featuring 2.0B on-chip CAN with extended Philips PeliCAN
- instruction cycle time of 375 ns at 16 MHz clock speed (no internal clock prescaler)
- 128 kByte external SRAM
- 128 (to 512) kByte external Flash supporting on-board downloading of user code from a host-PC in conjunction with PHYTEC FlashTools98 firmware
- RS-232 serial interface
- 2.0B CAN bus interface supporting 11-bit and 29-bit message identifiers
- 6-channel on-chip A/D converter with 10-bit resolution
- three Chip Select signals for connection to external peripherals
- requires only a +5 V/250 mA power source
- operates in a temperature range of 0... 70°C (optional -40... 85°C temperature range available)

The phyCORE Development Board LD 5V, in EURO-card dimensions (160 x 100 mm), is fully equipped with all mechanical and electrical components necessary for the speedy and secure insertion, and subsequent programming, of PHYTEC phyCORE series Single Board Computers with standard width (2.54 mm/ 0.10 in.) pin header connectors. Simple jumper configuration readies the Development Board's connection to any phyCORE module (standard header pins), which plug pins-down into the contact strips mounted on the phyCORE Development Board LD 5V.

phyCORE Development Board LD 5V Technical Highlights

- Reset signal controlled by push button or RS-232 control line CTS0
- Boot signal controlled by push button or RS-232 control line DSR0
- low voltage socket for supply with regulated input voltage 5 VDC
- additional supply voltage 3.3 VDC
- two DB-9 sockets (P1A, P1B) configurable as RS-232 interfaces
- two additional DB-9 plugs (P2A, P2B) configurable as CAN interfaces, connector P2B optionally configurable as RS-485 interface
- simple jumper configuration allowing use of the phyCORE Development Board LD 5V with various PHYTEC phyCORE SBC's
- one control LED D3 for quick testing of user software
- 2 x 160-pin Molex connector (X2) enabling easy connectivity to expansion boards (e.g. PHYTEC GPIO Expansion Board)

1.5 The Tasking 8051 Embedded Development Environment (EDE)

The Tasking tool chain fully supports the entire 8051-derivative microcontroller family, including the Philips P8xC591 family. It includes a C compiler, macroassembler, linker/locator and the CrossView Pro simulator and ROM monitor debugger within the EDE development environment.

Note:

The Tasking tool chain supports all in-circuit emulators that adhere to the IEEE-695 debugging specification or support the Tasking a.out format. The IHEX51 object-to-hex converter converts an absolute object file into an Intel-hexfile that is suitable for programming into an EPROM device or downloading into external Flash on the PHYTEC phyCORE-591 target board.

The Tasking tool chain consists of the following executables:

- **C Compiler** cc51.exe
- **Macro Preprocessor** mpp51.exe
- **Assembler** asm51.exe
- **Linker/Locator** link51.exe
- **HEX converter** ihex51.exe
- **Make Utility** mk51.exe
- **IEEE-695 converter** ieee51.exe
- **SREC converter** srec51.exe
- **Object dumper** dmp51.exe (not in eval version)
- **Library archiver** ar51.exe (not in eval version)
- **CrossView Pro** xvw51.exe (Windows-based)
- **EDE** ede.exe (Windows-based)

Once installed, the default destination location for these files is the **C:\DCC51\bin** folder for the evaluation version. If using the professional (i.e. full) version of the Tasking tool chain, the default destination location for these files is **C:\CC51\bin**. The executables are 32-bit Windows programs that run in command line mode except for CrossView Pro and EDE which are Windows-based applications. Access to these programs from Windows is accomplished with EDE. The entire tool set can be run from EDE or directly from command line using batch or make files.

The Tasking tools are also available for UNIX.

Embedded Development Environment (EDE)

EDE is a Windows-based Graphical User Interface for the C compiler and assembler. All compiler, assembler and linker options are set with simple mouse clicks. EDE runs under Windows 95/98/2000 and NT. This Embedded Development Environment has been expressly designed with the user in mind and includes a fully functional editor based on the popular Codewright editor from Starbase.

All EDE commands and functions are accessible via intuitive pull-down menus with prompted selections. An extensive Help utility and the complete set of online manuals is included. External executables can be run from within EDE, including emulator software.

8051 C Compiler

The 8051 ANSI C compiler and ASM51 assembler are designed specifically for 8051 controllers. All common derivatives from Philips, Infineon, Dallas, Intel and Atmel can be selected from a list in the EDE Processor Options menu.

The Tasking 8051 compiler provides the fastest and smallest code using industry benchmarks.

MPP51 Macro Preprocessor/ASM51 Assembler

The macro preprocessor and the assembler are started subsequently by the EDE environment. It is also possible to pass a file directly to the assembler when it does not need any macro expansion.

Debug Environment

CrossView Pro is a software simulator/ROM monitor debugger that supports debugging either via software on a host-PC or in target hardware. CrossView Pro enables the following debugging functions:

- run/halt, instruction/source stepping
- set (complex) breakpoints
- examine/change memory
- view the stack
- simulated I/O
- extended logging and scripting language
- powerful C like command language
- communication via RS-232

The CrossView Pro Simulator supports code coverage and profiling to ensure your code runs efficiently, and high level language trace.

The restrictions of the evaluation version of the Tasking 8051 tool set are described in '*C:\dcc51\doc\limit51.hlp*'. Other than these restrictions, the evaluation tool chain functions exactly as the full version. The evaluation version does not have a starting address restriction and produces useful object code. This allows you to fully evaluate the features of Tasking products in conjunction with the PHYTEC Single Board Computer module. The full version has no restrictions and is fully ANSI compliant.

2 Getting Started

What you will learn with this Getting Started example:

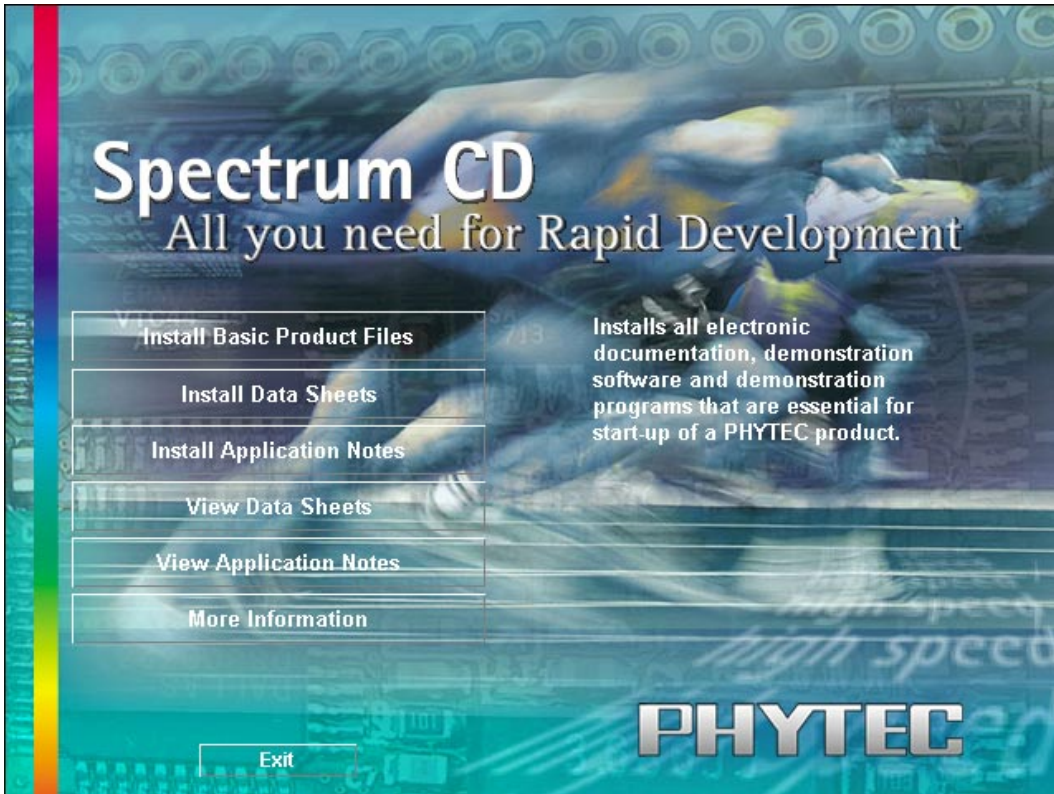
- installing Rapid Development Kit software
- starting PHYTEC FlashTools98 for Windows download utility
- interfacing the phyCORE-P87C591, mounted on the phyCORE Development Board LD 5V, to a host-PC
- downloading example user code in Intel hexfile format from a host-PC to the external Flash memory using FlashTools98

2.1 Installing Rapid Development Kit Software

- Insert the PHYTEC Spectrum CD into the CD-ROM drive of your host-PC

The PHYTEC Spectrum CD should automatically launch a setup program that installs the software required for the Rapid Development Kit as specified by the user. Otherwise the setup program *start.exe* can be manually executed from the root directory of the PHYTEC Spectrum CD.

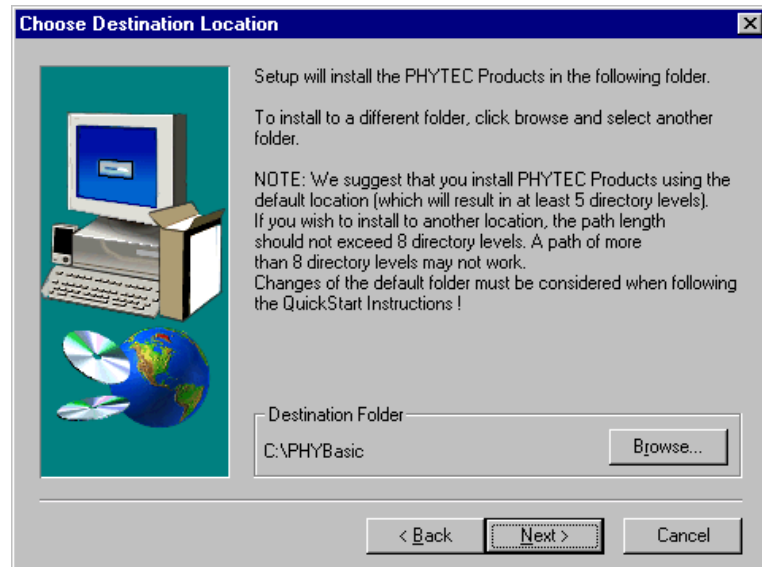
The following window appears:



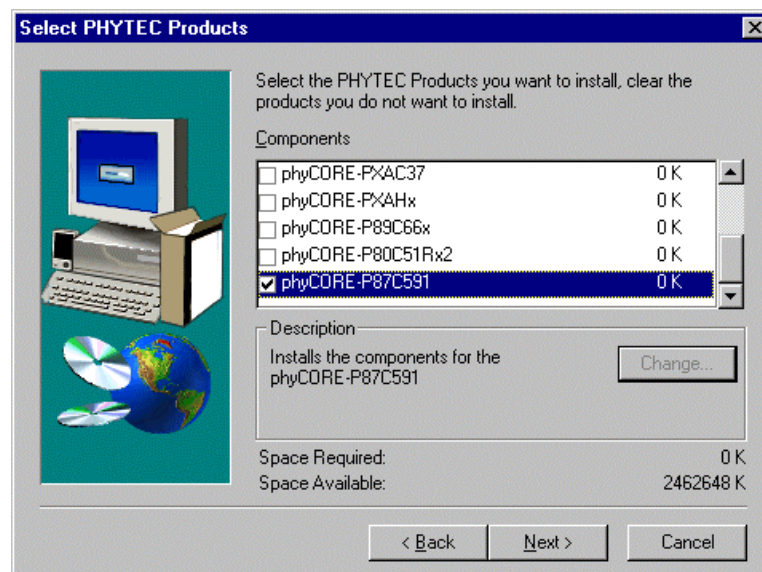
- Choose the *Install Basic Product Files* button.
- After accepting the Welcome window and license agreement, select the destination location for installation of Rapid Development Kit software and documentation.

The default destination location is **C:\PHYBasic**. All path and file statements within this QuickStart Instruction are based on the assumption that you accept the default install paths and drives. If you decide to individually choose different paths and/or drives you must consider this for all further file and path statements.

We recommend that you accept the default destination location.



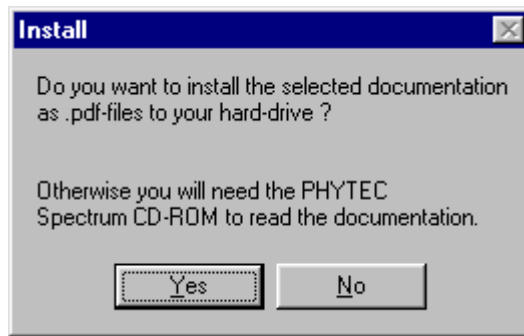
- In the next window, select your Rapid Development Kit of choice from the list of available products. By using the *Change* button, advanced users can select in detail which options should be installed for a specific product.



All Kit-specific content will be installed to a Kit-specific subfolder of the Rapid Development Kit root folder that you have specified at the beginning of the installation process.

All software and tools for this phyCORE-P87C591 RDK will be installed to the **|PHYBasic** folder on your hard drive.

- In the next dialog you must choose whether to copy the selected documentation as ***.pdf** files to your hard drive or to install a link to the file on the Spectrum CD.



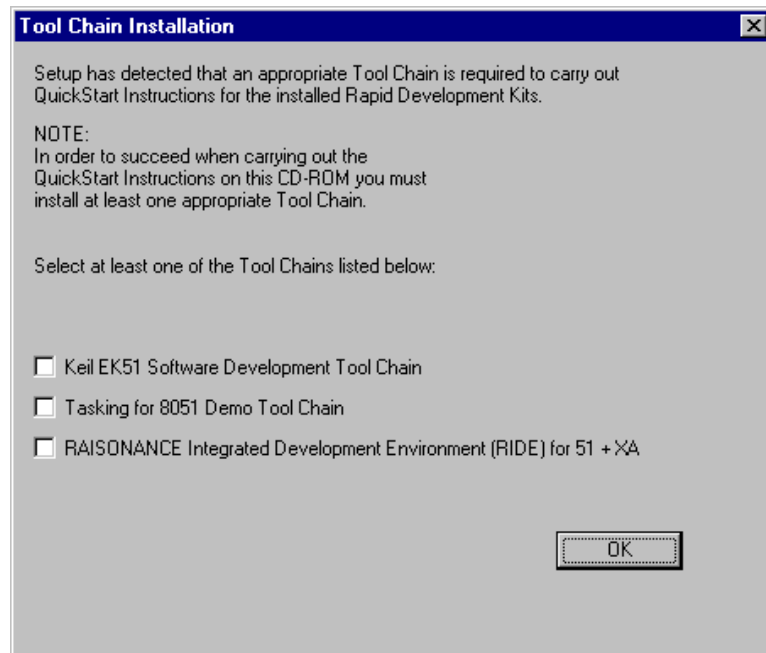
If you decide **not** to copy the documentation to your hard drive, you will need the PHYTEC Spectrum CD-ROM each time you want to access these documents. The installed links will refer to your CD-ROM drive in this case.

If you decide to copy the electronic documentation to your hard drive, the documentation for this phyCORE-P87C591 RDK will also be installed to the kit-specific subfolder. The manuals of the phyCORE Development Board LD 5V are copied to their own specific subfolder (e.g. **|PHYBasic|DevBLD5V**) because each Development Board is suitable for multiple SBC's and is not dedicated to a specific RDK.

Setup will now add program icons to the program folder, named **PHYTEC**.

- Press *Finish* to complete the installation of PHYTEC products.

In the next window, choose the Tasking for 8051 Software Development Tool Chain for installation¹.



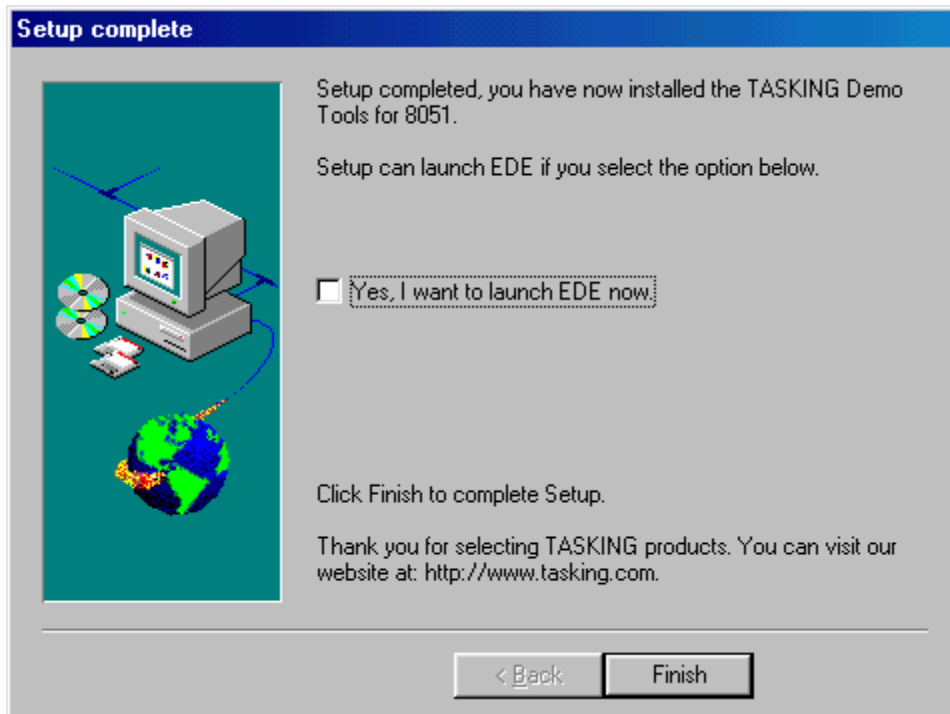
The applicable Tasking tool chain must be installed to ensure successful completion of this QuickStart Instruction. Failure to install the proper software could lead to possible version conflicts, resulting in functional problems.

We recommend that you install Tasking for 8051 from the Spectrum CD-ROM even if other versions of the Tasking tool chain are already installed on your system. These QuickStart Instructions and the demo software included on the CD-ROM have been specifically tailored for use with one another.

- After accepting the Welcome window and license agreement, select the destination location for installation of the Tasking for 8051 demo tool chain. The default location is **C:\Dcc51**.

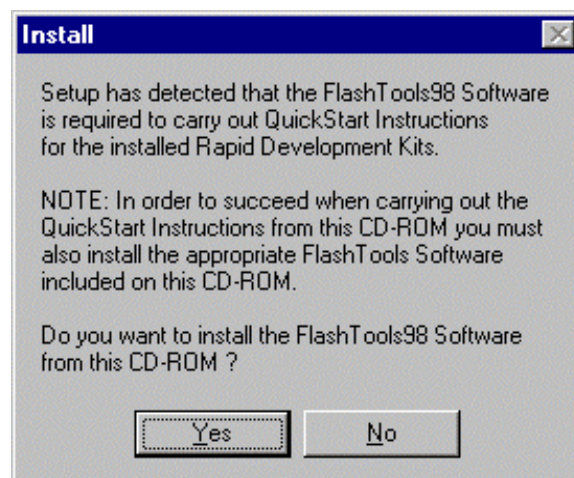
¹: If installing a different Software Development tool chain, *please refer to the applicable version of the QuickStart manual*.

- Disable the check box 'Yes, I want to launch EDE now', the Tasking tool chain is not required for the first examples. Click on *Finish* to exit this installation step.

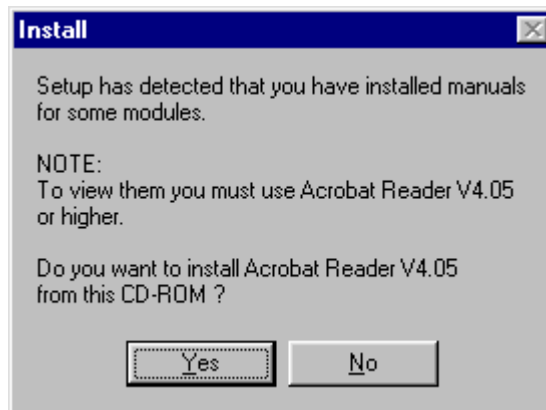


Additional software, such as Adobe Acrobat Reader, will also be offered for installation.

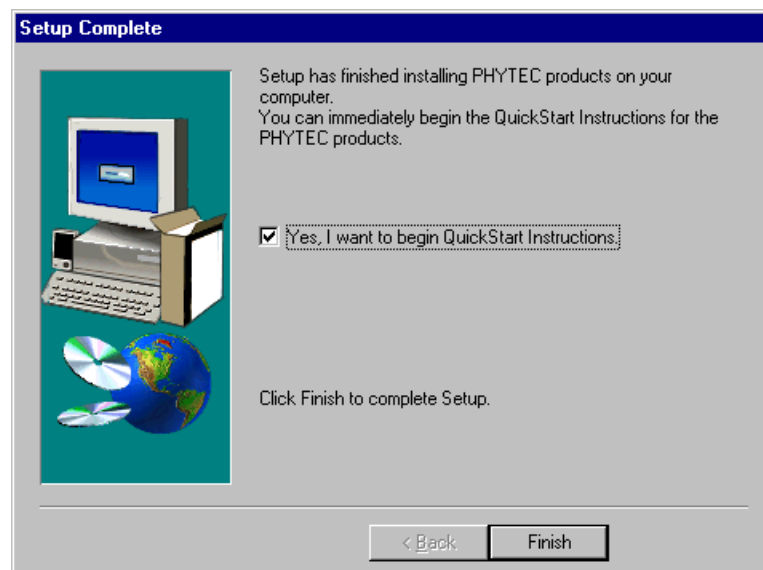
In the following windows you can decide to install FlashTools98 software and the Acrobat Reader.



The applicable FlashTools software must be installed to ensure successful completion of this QuickStart Instruction. Failure to install the proper software could lead to possible version conflicts, resulting in functional problems.



- Decide if you want to begin the QuickStart Instruction immediately by selecting the appropriate checkbox and press *Finish* to complete the installation.



2.2 Interfacing the phyCORE-P87C591 to a Host-PC

Connecting the phyCORE-P87C591, mounted on the phyCORE Development Board LD 5V, to your computer is simple:

- As shown in the figure below, if the phyCORE module is not already preinstalled, mount it pins-down onto the Development Board's receptacle footprint (X6).
- Ensure that pin 1 of module (denoted by the hash stencil mark on the PCB) matches pin 1 of the receptacle on the phyCORE Development Board LD 5V.
- Ensure that there is a solid connection between the module pins and the phyCORE Development Board LD 5V receptacle.

Caution:

Take precautions not to bend the pins when the phyCORE module is removed from and inserted onto the phyCORE Development Board LD 5V.

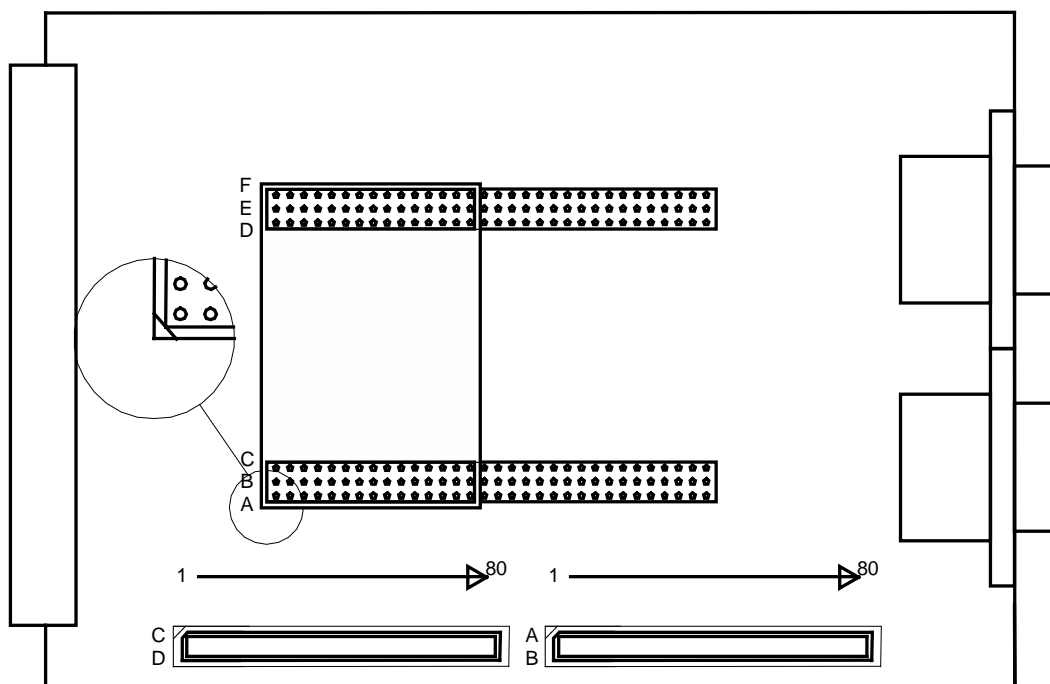


Figure 1: Mounting the phyCORE-P87C591 onto the phyCORE Development Board LD 5V

- Configure the jumpers on the phyCORE Development Board LD 5V as indicated below. This correctly routes the RS-232 signals to the DB-9 connector (P1A = bottom) and connects the Development Board's peripheral devices to the phyCORE module.

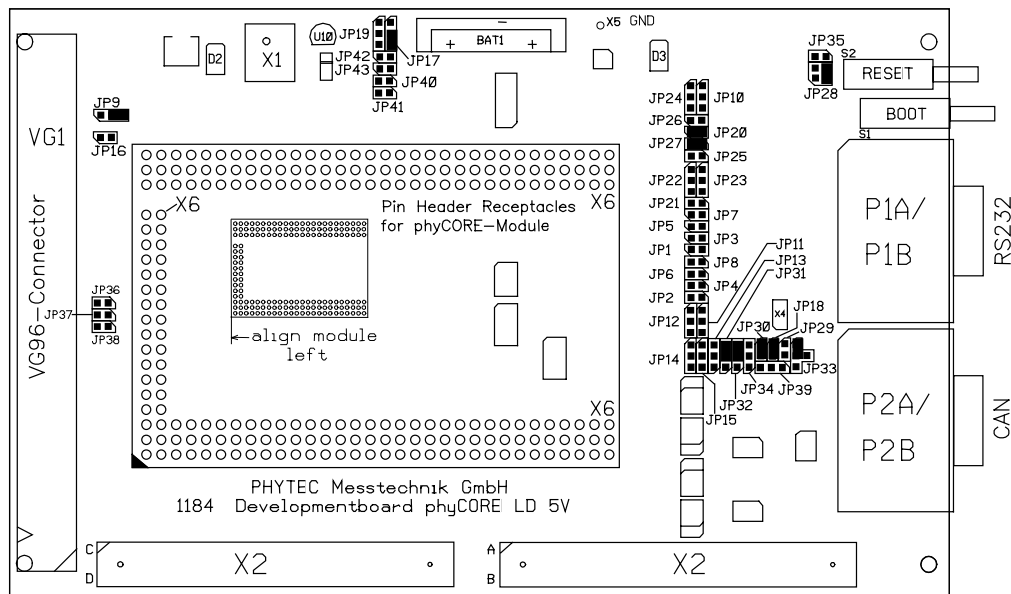


Figure 2: Important Connectors, Buttons and Suitable Jumper Settings on the phyCORE Development Board LD 5V

- Connect the RS-232 interface of your computer to the DB-9 RS-232 interface on the phyCORE Development Board LD 5V (P1A = bottom) using the included serial cable.
- Using the included power adapter, connect the power socket on the board (X1) to a power supply (refer to Figure 4 for the correct polarity).

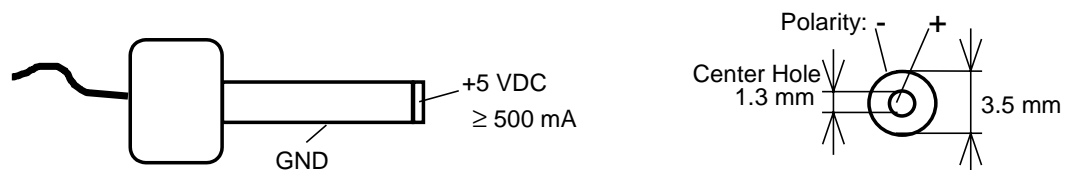


Figure 3: Power Connector

- Simultaneously press the Reset (S2) and Boot (S1) buttons on the phyCORE Development Board LD 5V, first releasing the Reset and then, two or three seconds later, release the Boot button.

This sequence of pressing and releasing the Reset (S2) and Boot (S1) button renders the phyCORE-P87C591 into the Flash programming mode (FPM). Use of FlashTools98 always requires the phyCORE-P87C591 to be in FPM. See *section 2.4, “Downloading Example Code with FlashTools”* for more details.

The phyCORE module should now be properly connected via the phyCORE Development Board LD 5V to a host-PC and power supply. After executing a Reset and rendering the board in Flash programming mode, you are now ready to program the phyCORE-P87C591. This phyCORE module/phyCORE Development Board LD 5V combination is also referred to as “target hardware”.

2.3 Starting PHYTEC FlashTools98 for Windows

FlashTools98 should have been installed during the initial setup procedure as described in *section 5.1*. If not, you can manually install it using the *setup.exe* file located in the folder `\Software\Flasht98\`.

FlashTools98 for Windows is a utility program that allows download of user code in Intel **.hex* file format from a host-PC to a PHYTEC SBC via an RS-232 connection.

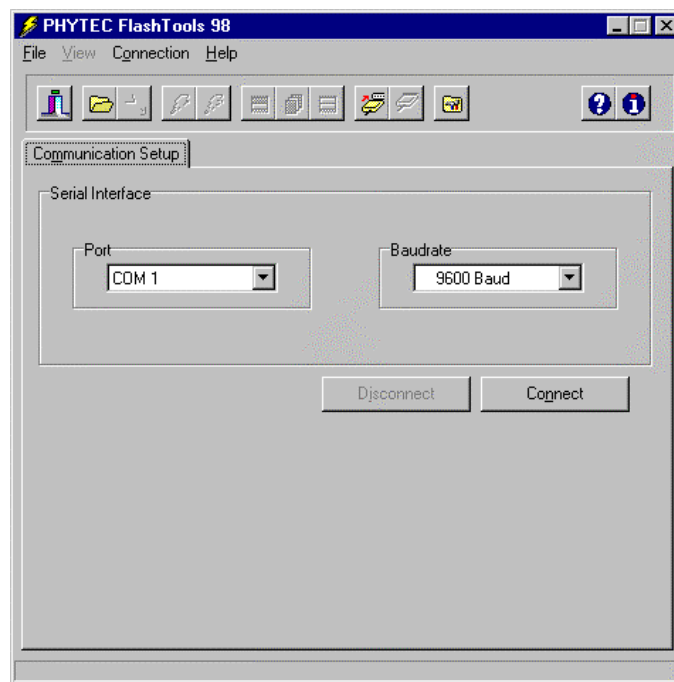
FlashTools98 consists of firmware resident in the external Flash and corresponding software installed on the host-PC. Proper connection of a PHYTEC SBC to a host-PC enables the software portion of FlashTools98 to recognize and communicate to the firmware portion.

- You can start FlashTools98 by selecting it from the *Programs* menu using the Windows *Start* button.

It is recommended that you drag the FlashTools98 icon onto the desktop of your PC. This enables easy start of FlashTools98 by double-clicking on the icon.

2.4 Downloading Example Code with FlashTools

- Start FlashTools98 for Windows by double-clicking on the FlashTools98 icon or by selecting *FlashTools98* from within the *Programs/Phytec* program group.
- The Communication Setup tab of the FlashTools98 tabsheet window will now appear. Here you can specify connection properties to the phyCORE-P87C591.



- Choose the correct serial port for your host-PC and a 9,600 baud rate.

Note:

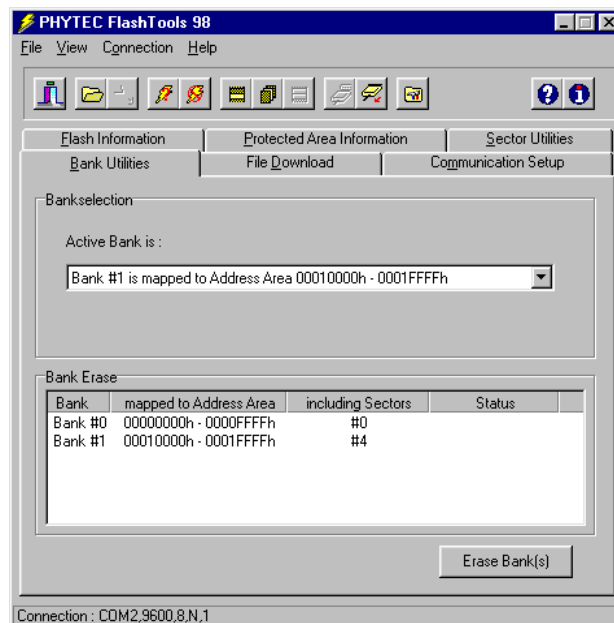
Always ensure that the phyCORE-P87C591 is in Flash programming mode before pressing the *Connect* button.

- Click the *Connect* button to establish connection to the target hardware.

The microcontroller firmware tries to automatically adjust to the baud rate selected within the baud rate tab. However, it may occur that the selected baud rate can not be attained. This results in a connection error. In this case, try other baud rates to establish a connection. Before attempting each connection, be sure to reset the target hardware and render it into Flash programming mode (FPM) as described in *section 2.2*.

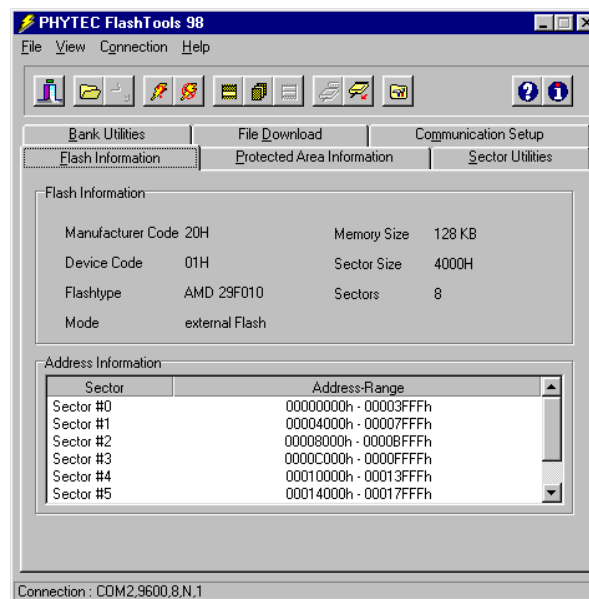
Returning to the FlashTool98 tabsheet window, you will see tabs for the following:

*Bank Utilities*² enable erasure and status check of whole banks of memory specified by the user:

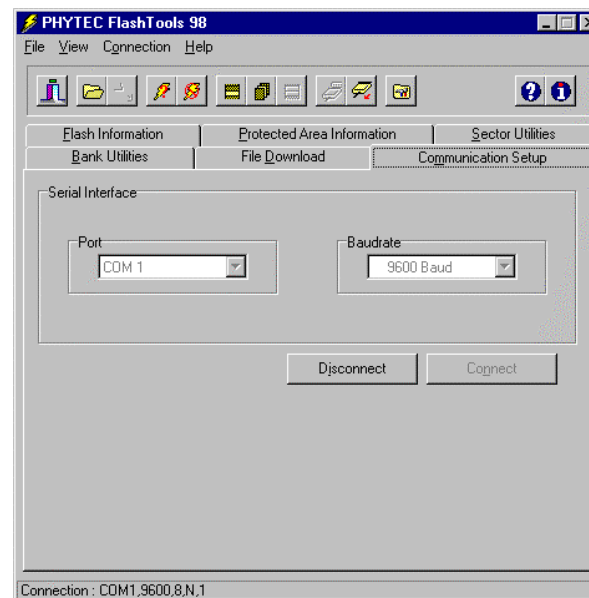


²: The number of banks shown on the *Bank Utilities* tabsheet varies depending on the size and type of the Flash mounted on the phyCORE-P87C591.

*Flash Information*³ shows Flash type, sector and address ranges in Flash memory:

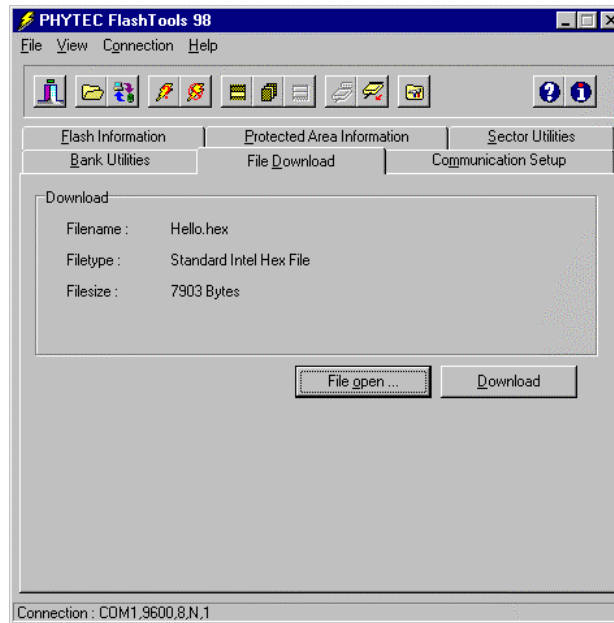


Communication Setup allows selection of the serial port and speed before the communication is initialized, or to disconnect the ongoing communication:

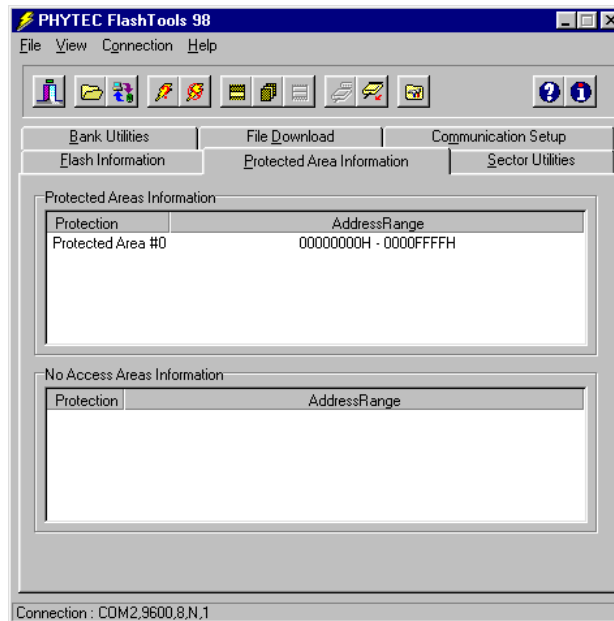


³: The appearance of the *Flash Information* tabsheet varies depending on the size and type of the Flash mounted on the phyCORE-P87C591.

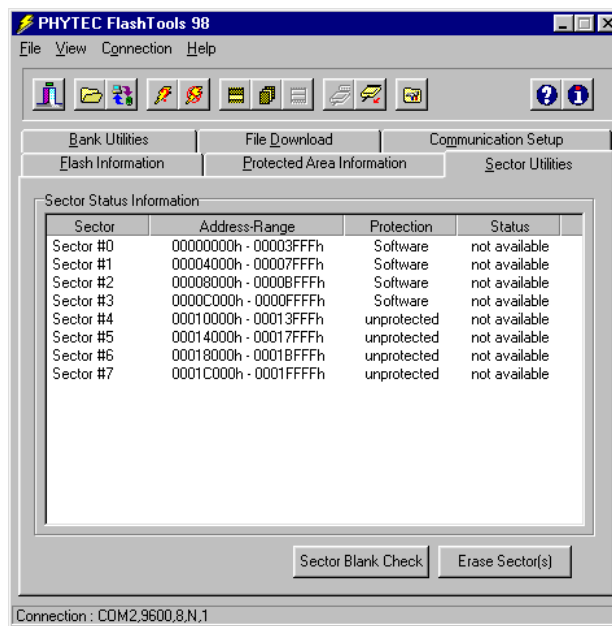
File Download downloads specified hexfiles to the target hardware:



Protected Areas Information shows protected areas of Flash memory:



*Sector Utilities*⁴ enable erasure and status check of individual sectors of Flash memory specified by the user:



⁴: The appearance of the *Sector Utilities* tabsheet varies depending on the size and type of the Flash mounted on the phyCORE-P87C591.

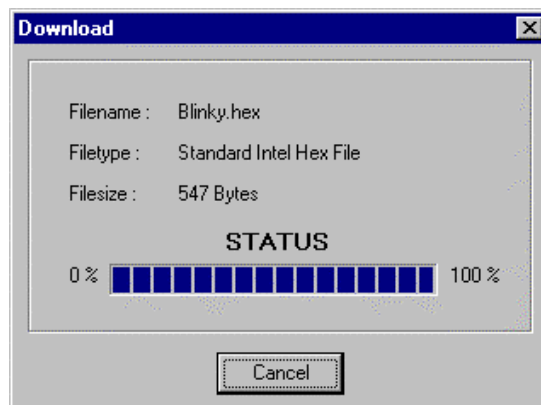
2.4.1 "Blinky"

The "Blinky" example downloads a program to the Flash that, when executed, manipulates the LED D3 on the phyCORE Development Board LD 5V that is located above the jumper field (refer to Figure 2):

- Returning to the FlashTools98 tabsheet, choose the *Bank Utilities* tab, highlight *Bank #1* within the *Bank Erase* section, and click on the *Erase Bank(s)* button to erase this memory bank.
- Wait until the status check in the lower left corner of the FlashTools98 tabsheet finishes, returning the connection properties description to the lower left corner of the window.
- Next choose the *File Download* tab and click on the *File Open* button.

The hexfile has already been installed to your hard drive during the installation procedure.

- Browse to the correct drive and path for the phyCORE-P87C591 Demo folder (default location *C:\PHYBasic\pC-P87C591\Demos\Tasking\Blinky\Blinky.hex*) and click *Open*.
- Click on the *Download* button. You can watch the status of the download of the *Blinky.hex* into external Flash memory in the Download window.



If the selected Flash bank into which you wish to download code is not empty (i.e. erased), a warning dialog box will appear, indicating “Location not empty! Please erase location and try again”. In this event, select the *Bank Utilities* tab from the FlashTools98 tabsheet, highlight *Bank #1* and erase the bank. Then repeat the download procedure.

- At the end of the download, a sector-by-sector status check of the Flash memory can be viewed in the lower left corner of the FlashTools98 tabsheet window. Wait until the status check finishes before returning to work with the board. Once the status check is complete, the downloaded code can be executed.
- Returning to the *Communication* tab, click on the *Disconnect* button and exit FlashTools98.
- Press the Reset button (S2) on the phyCORE Development Board LD 5V to reset the target hardware and to start execution of the downloaded software.
- Successful execution of the program will flash the LED D3 with equal on and off durations.

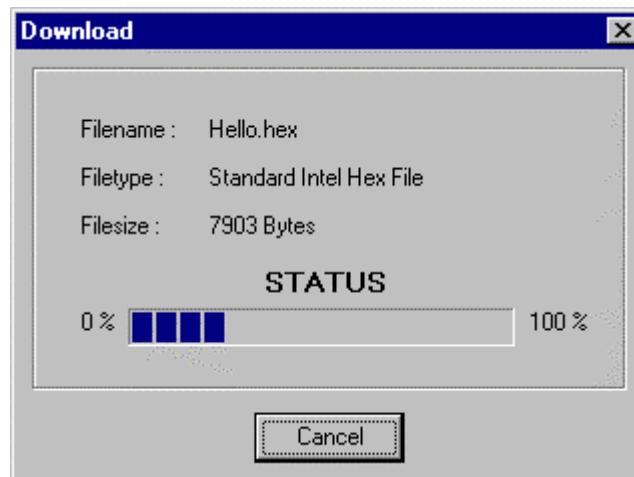
2.4.2 "Hello"

The “Hello” example downloads a program to the Flash that, when executed, performs an automatic baud rate detection and sends a character string from the target hardware back to the host-PC. The character string can be viewed with a terminal emulation program. This example program provides a review of the FlashTools98 download procedure. For detailed commentary on each step, described below in concise form, *refer back to sections 2.2 through 2.4.1.*

- Ensure that the target hardware is properly connected to the host-PC and a power supply.
- Reset the target hardware and force it into Flash programming mode by simultaneously pressing the Reset (S2) and Boot (S1) buttons on the phyCORE Development Board LD 5V and then releasing first the Reset and, two or three seconds later, the Boot button.
- Start FlashTools98.
- At the *Communication Setup* tab of the FlashTools98 tabsheet, specify the proper serial port and transmission speed (9,600 baud) for communication between host-PC and target hardware and click the *Connect* button to establish connection to the target hardware.
- Returning to the FlashTools98 tabsheet, choose the *Bank Utilities* tab, highlight *Bank #1* within the *Bank Erase* section, and click on the *Erase Bank(s)* button to erase this memory bank.
- Wait until the status check in the lower left corner of the FlashTools98 tabsheet finishes, returning the connection properties description to the lower left corner of the window.
- Next choose the *File Download* tab and click on the *File Open* button.

The demo hexfile has already been installed to your hard drive during the installation procedure.

- Browse to the correct drive and path for the phyCORE-P87C591 Demo folder (default location ***C:\PHYBasic\pC-P87C591\Demos\Tasking\Hello\Hello.hex***) and click *Open*.
- Click on the *Download* button. You can watch the status of the download of the ***Hello.hex*** into external Flash memory in the Download window.



If the selected Flash bank into which you wish to download code is not empty (i.e. erased), a warning dialog box will appear, indicating “Location not empty! Please erase location and try again”. In this event, select the *Bank Utilities* tab from the FlashTools98 tabsheet, highlight *Bank #1* and erase the bank. Then repeat the download procedure.

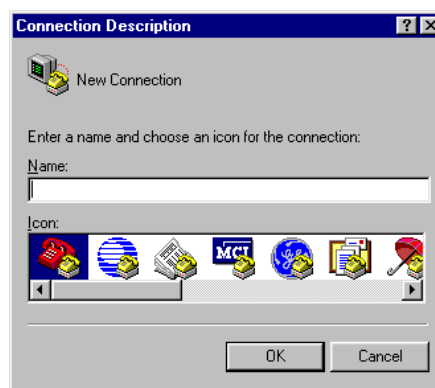
- At the end of the download, a sector-by-sector status check of the Flash memory can be viewed in the lower left corner of the FlashTools98 tabsheet window. Wait until the status check finishes before returning to work with the board. Once the status check is complete, the downloaded code can be executed.
- Returning to the *Communication* tab, click on the *Disconnect* button and exit FlashTools98.

Monitoring the execution of the Hello demo requires use of a terminal program, such as the HyperTerminal program included within Windows.

- Start the HyperTerminal program within the *Programs/Accessories* bar.
- The HyperTerminal main window will now appear⁵:
- Double-click on the HyperTerminal icon “*Hypertrm*” to create a new HyperTerminal session.

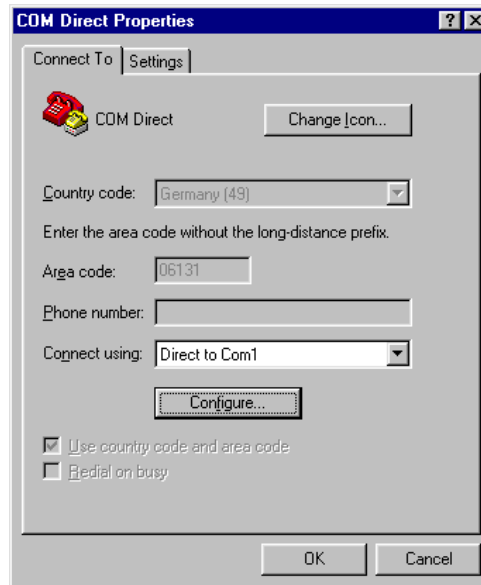


- The Connection Description window will now appear. Enter “COM Direct” in the *Name* text field.
- Next click on *OK*. This creates a new HyperTerminal session named “COM Direct” and advances you to the next HyperTerminal window.

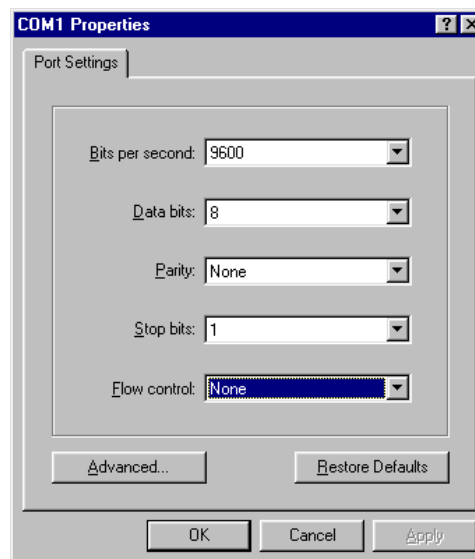


⁵ : The HyperTerminal window has a different appearance for different versions of Windows.

- The *COM Direct Properties* window will now appear. Specify *Direct to COM1/COM2* under the *Connect Using* pull-down menu (be sure to indicate the correct COM setting for your system).

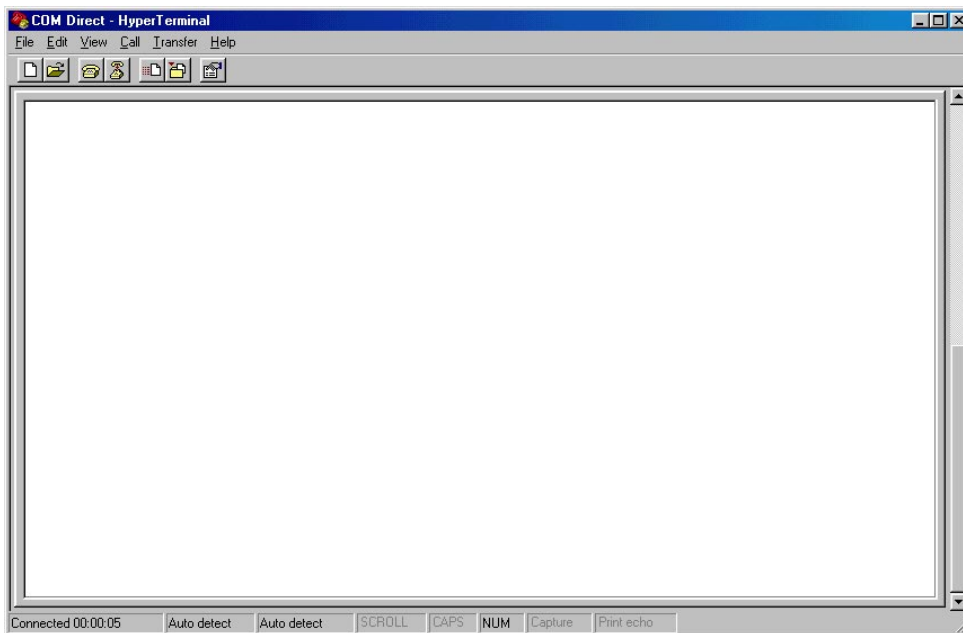


- Click the *Configure* button in the *COM Direct Properties* window to advance to the next window (*COM1/COM2 Properties*).




- Set the following COM parameters: Bits per second = 9600; Data bits = 8; Parity = None; Stop Bits = 1; Flow Control = None.

- Selecting *OK* advances you to the *COM Direct-HyperTerminal* monitoring window. Notice the connection status report in the lower left corner of the window.



- Resetting the phyCORE Development Board LD 5V (at S2) will execute the ***Hello.hex*** file loaded into the Flash.
- Now push the <Space> bar on your keyboard once to start the automatic baud rate detection on phyCORE-P87C591 module.
- Successful execution will send the character string "*Hello World*" from the target hardware to the HyperTerminal window.

Pressing any other key than the <Space> bar leads to an improper baud rate since the automatic baud rate detection is based on the timing measurement during the transmission of a well known character – the <Space> character. As a result you may get incoherent characters in the HyperTerminal window.

- Click the disconnect icon  in HyperTerminal toolbar and exit HyperTerminal.
- If no output appears in the HyperTerminal window check the power supply, the COM parameters and the RS-232 connection.

You have now successfully downloaded and executed two pre-existing example programs in Intel ****.hex*** file format.

2.4.3 CAN Demonstration Program

This program demonstrates the Controller Area Networking (CAN) Self Reception Request function of the P87C591 microcontroller on the phyCORE-P87C591 module, used in conjunction with the phyCORE Development Board LD 5V. This CAN Self Reception capability allows messages passed on the CAN bus to be received and processed by the originating node. Pressing of the Boot button S1 on the Development Board initiates the transmission of a message over the CAN bus. The CAN identifier used for this example is 0x100.

The CAN message consists of only one data byte. The data byte 0x01 indicates that S1 is pressed, while the data byte 0x00 indicates that S1 is released. Using the Self Reception Request function of the P8x591 controller, the message will be transmitted to the internal CAN registers. It will then be returned to, and received by, the on-chip CAN controller. Depending on the received data byte, either LED D3 will illuminate (data byte 0x01) or not (data byte 0x00).

Push Button	Data Byte Received	LED D3
S1 pressed	0x01	ON
S1 released	0x00	OFF

To download this demo program follow the steps described above using FlashTools98. The *Can.hex* demo file has already been installed to your hard-drive during the installation procedure. Its default location is:

C:\PHYBasic\pC-P87C591\Demos\Tasking\CAN\Can.hex

Press the Reset button (S2) on the phyCORE Development Board LD 5V to reset the target hardware and to start execution of this demo program. Pressing of Boot button S1 will light LED D3.

3 Getting More Involved

What you will learn with this example:

- how to start the Tasking tool chain
- how to configure the Tasking tools within the Embedded Development Environment (EDE)
- how to modify the source code from our examples, create a new project and build and download an output *.*hex*-file to the target hardware

3.1 Starting the Tasking Tool Chain

The Tasking 8051 Embedded Development Environment (EDE) evaluation software should have been installed during the install procedure, as described in *section 2.1*.

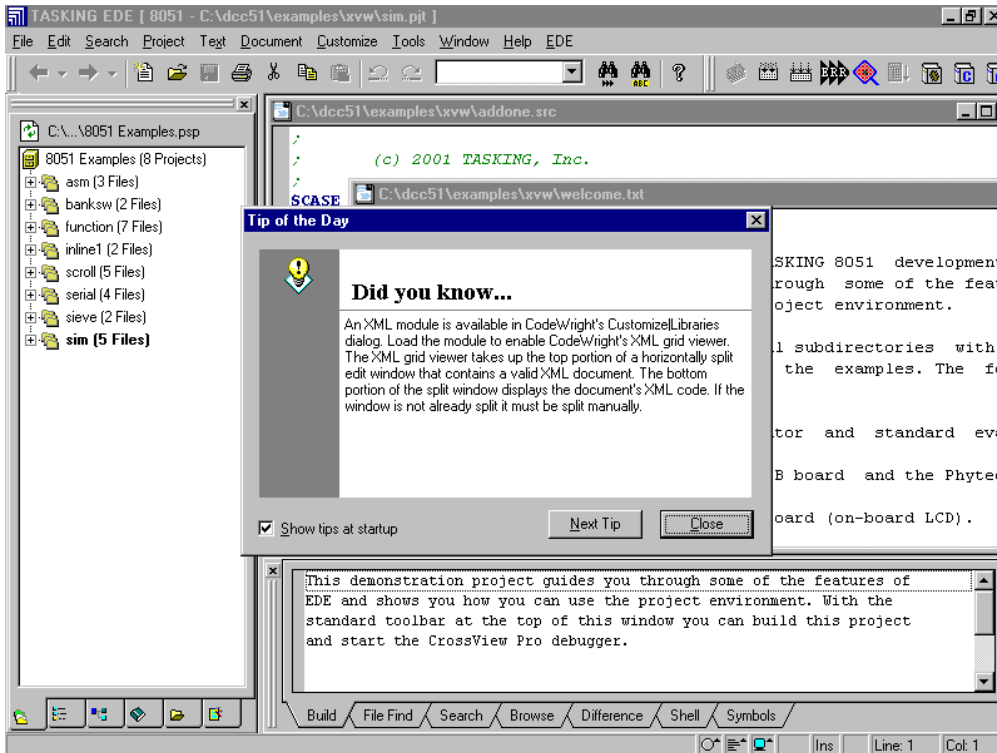
You can also manually install the tool chain by executing *setup.exe* from within the `\Software\Tasking\DCC51` folder of your PHYTEC Spectrum CD.

Note:

It is necessary to use the Tasking tool chain provided on the accompanying Spectrum CD in order to complete these QuickStart Instructions successfully. Use of a different version could lead to possible version conflicts, resulting in functional problems.

Start the tool chain by selecting *EDE* from within the *Programs/TASKING 8051 Demo* program group.

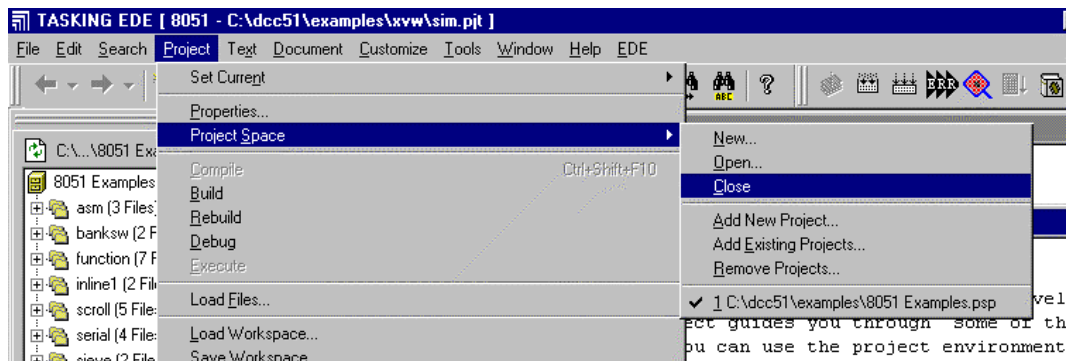
After you start EDE, the window shown below appears. From this window you can create projects, edit files, configure tools, compile, assemble, link and start the debugger. Other 3rd party tools such as emulators can also be started from here.



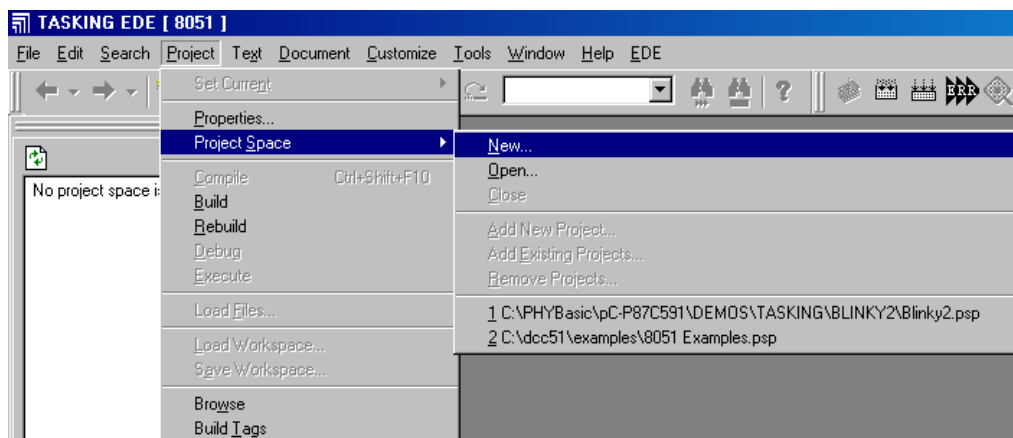
- You can close the **Tip of the Day** window.

3.2 Creating a New Project and Adding an Existing Source File

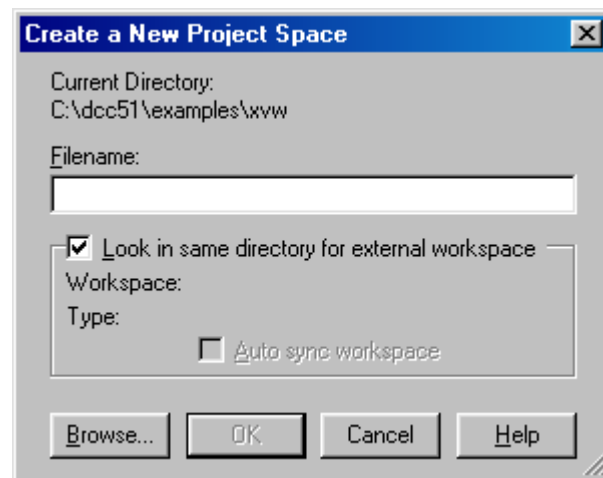
EDE 8051 automatically loads the most recently opened project. If you find an existing project when starting EDE 8051, close it by selecting the **Project** menu and **Project Space\Close** the project.



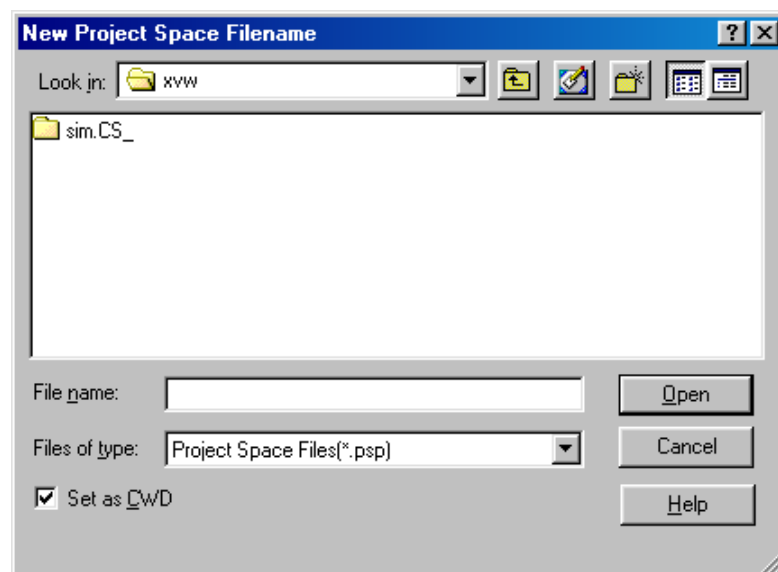
- To create a new project file select from the EDE 8051 menu **Project/Project Space\New...**



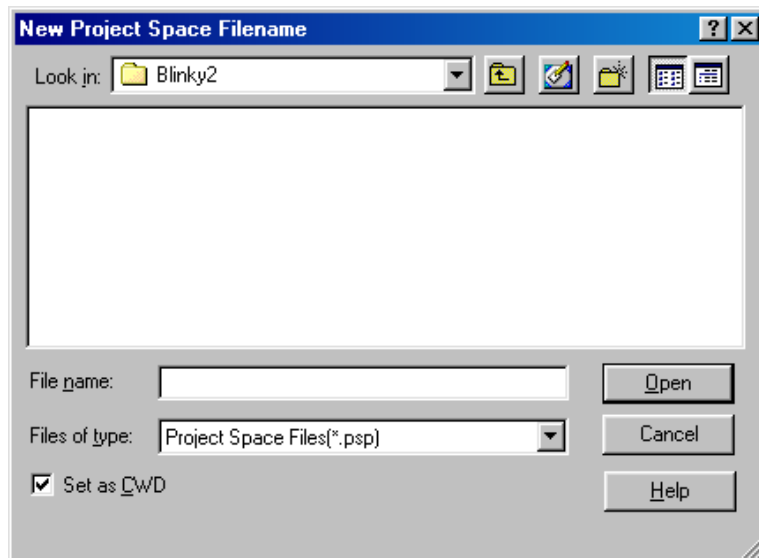
- The following window will appear:



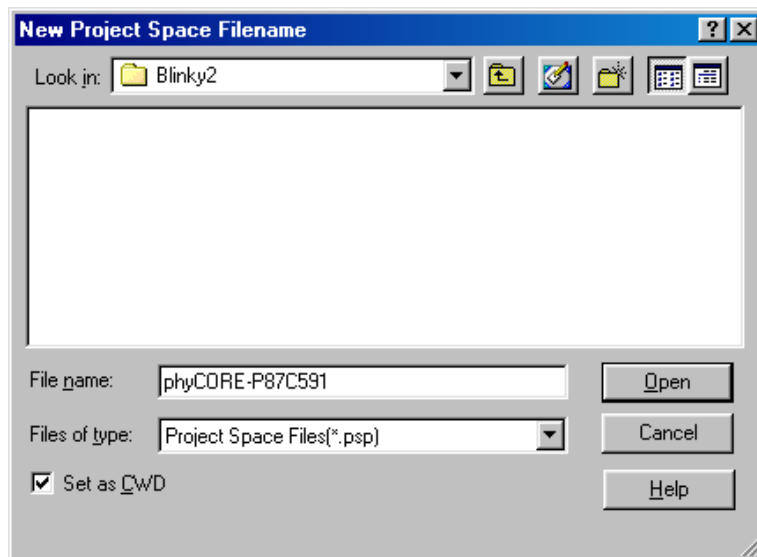
- Click on the **Browse** button in the *Create a New Project Space* window.
- This opens the *New Project Space Filename* window as shown below:



- In the *Look in:* pull-down menu, change to the project directory created by the installation procedure (default location *C:\PHYBasic\pC-P87C591\Demos\Tasking\Blinky2*).

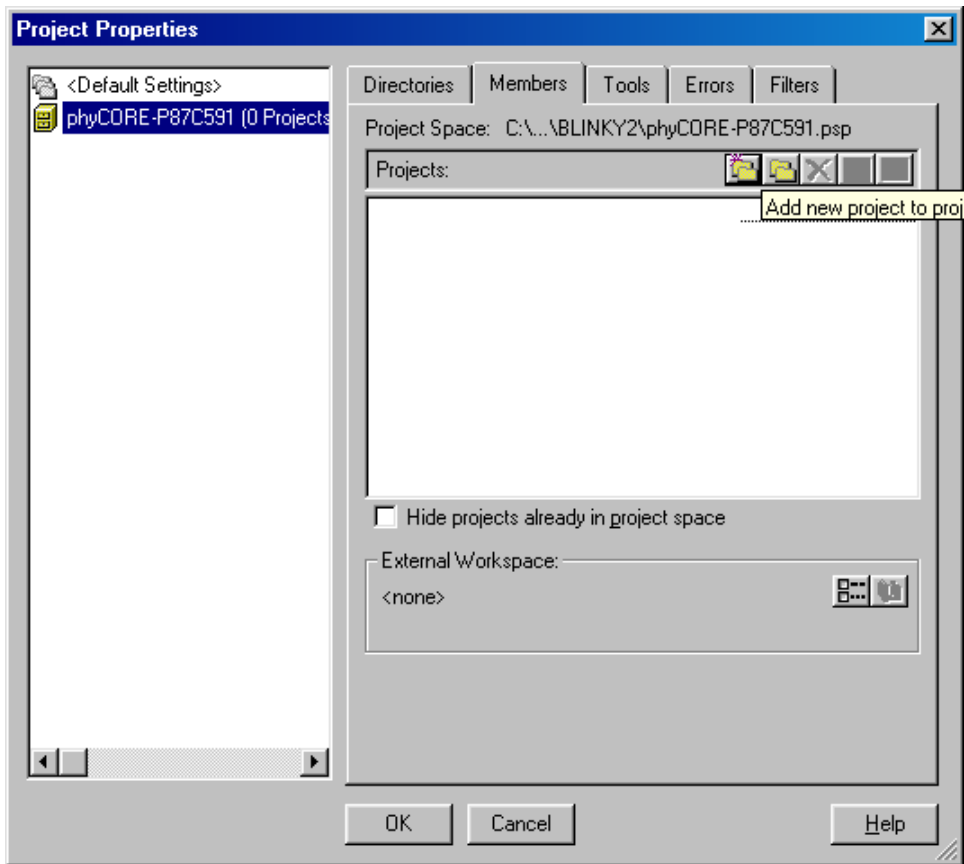


- In the text field '*File name*', enter the file name of the project space you are creating. For this example, enter the name *phyCORE-P87C591* and click on *Open*.

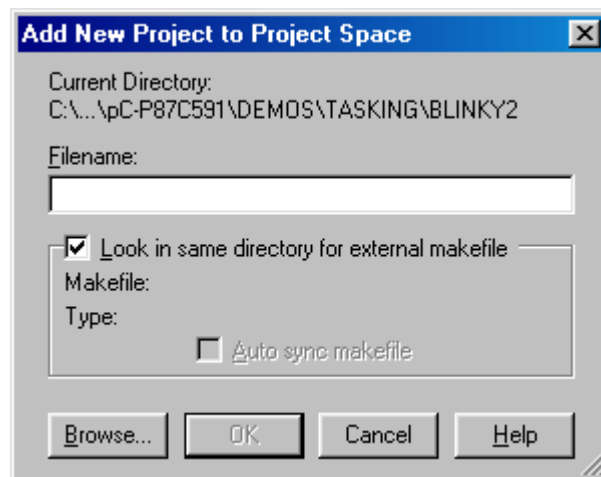


- Click on **OK** in the *Create a New Project Space* window.

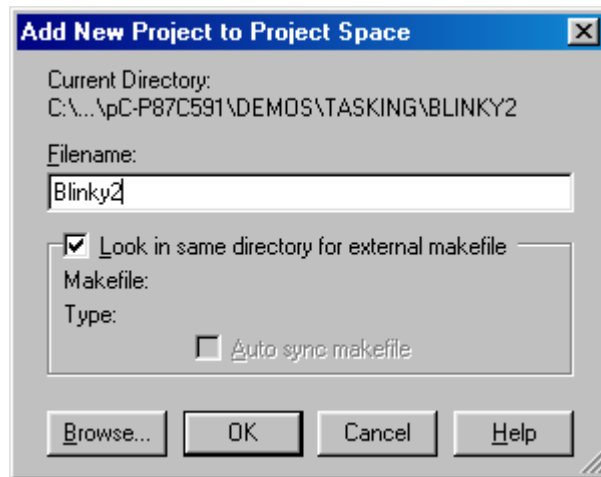
- The *Project Properties* window will now appear:



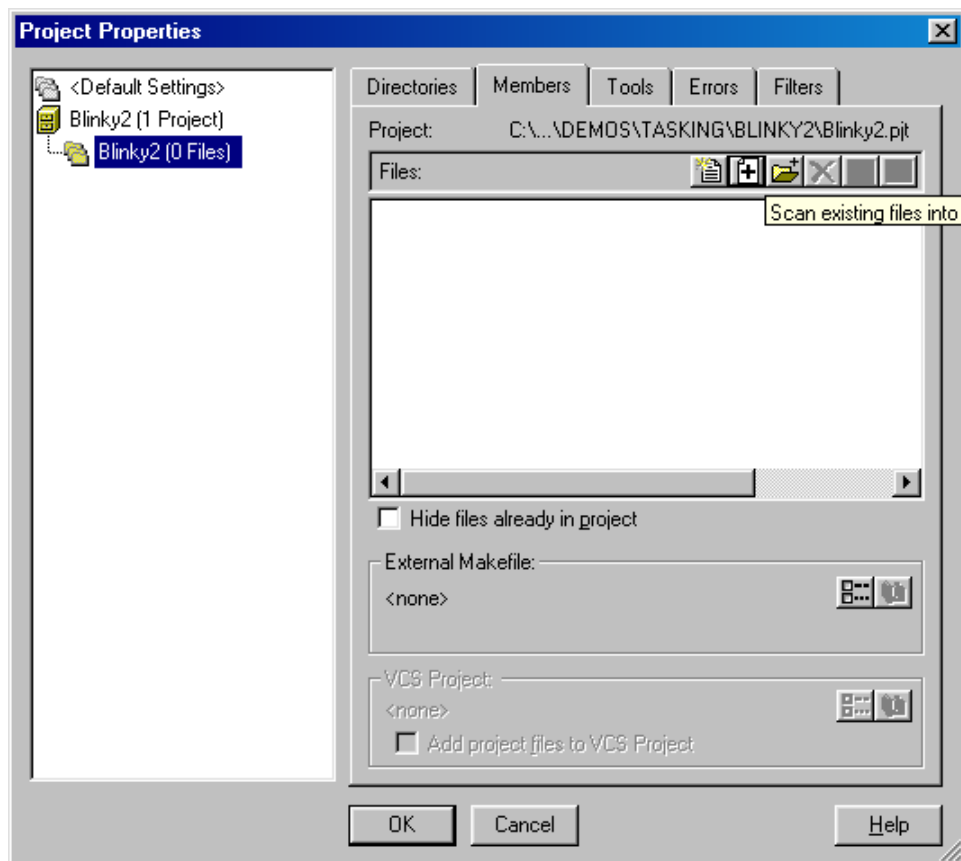
- Click on the *Add a new Project*  icon. The *Add New Project to Project Space* window will now appear:




- In the text field 'Filename' of the *Add New Project to Project Space* window, enter the file name of the project you are creating. For this example, enter the name **Blinky2** and click on **OK**.

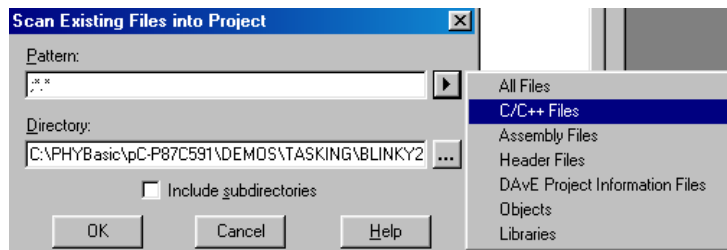


- The *Project Properties* window will now look like this:

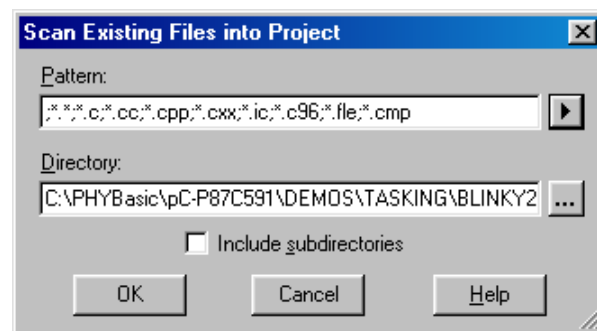


- Click on the *Scan existing files into project*  icon.

- In the pull-down menu *Pattern*, select *C/C++ Files* as shown below:

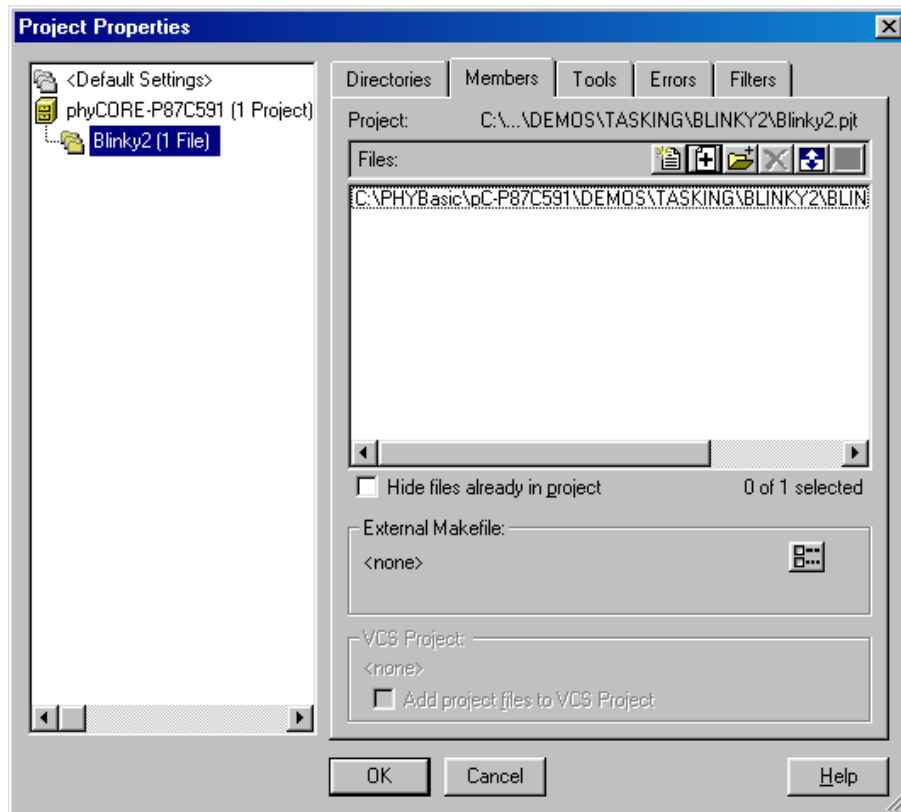


- The *Scan Existing Files into Project* window should now look like this:



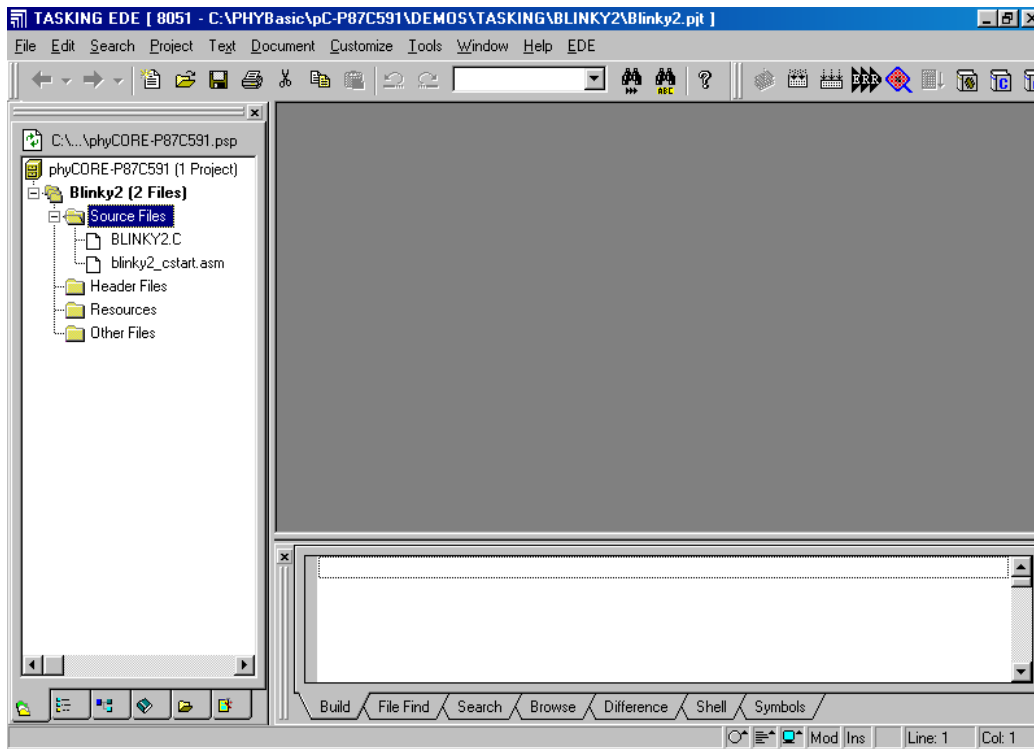
- Click on **OK** in the *Scan Existing Files into Project* window.

- The *Project Properties* window will now appear as follows:



- Click on **OK** in the *Project Properties* window.

The EDE 8051 project window now shows the project space *phyCORE-P87C591* with the *Blinky2* project including two source files. The group *Source Files* contains the C file *Blinky2.c* and the assembler file *blinky2_cstart.asm*.

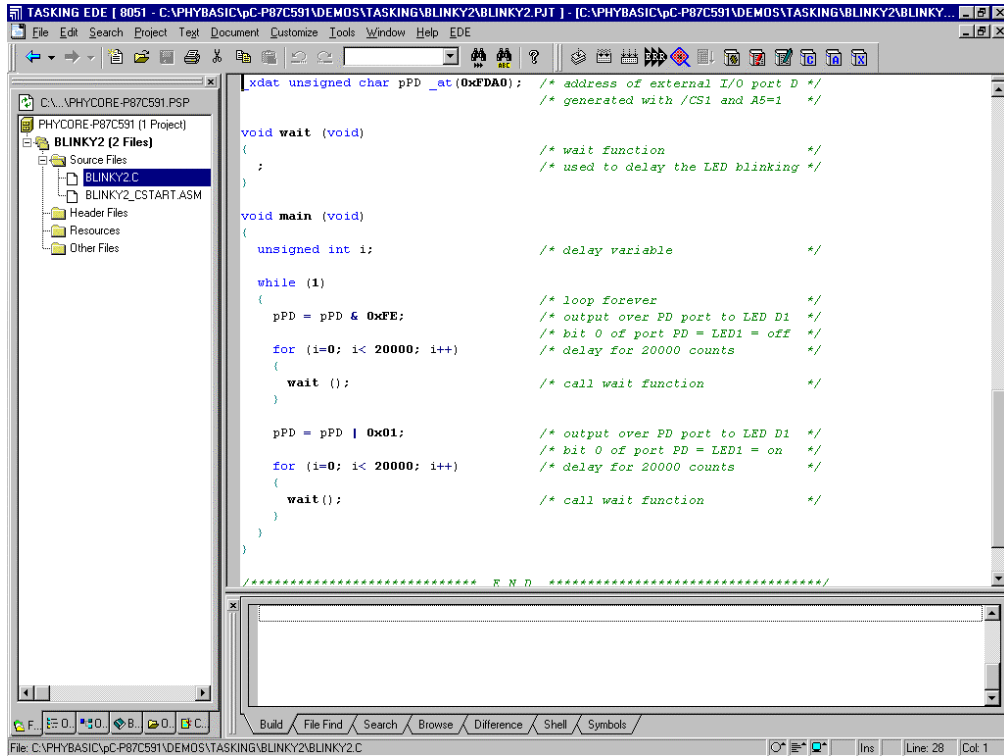


At this point you have created a project space called **phyCORE-P87C591**, a project called *Blinky2* and added an existing C source file called *Blinky2.c*. In addition, the EDE 8051 automatically created an assembler file *blinky2_cstart.asm* that contains specific startup code.

The next step is to modify the C source before building your project. This includes compiling, linking, locating and creating the hexfile.

3.2 Modifying the Source Code

- Double-click on *Blinky2.c* to open it in the source code editor.



- Locate the following code section. Modify the section shown below (the values shown in bold and italic) from the original (20,000) counts to the indicated values:


```

while (1) {
    pPD = pPD & 0xEF; /* output over PD port to LED D3 */
    /* bit 1 of port PD = LED D3 = OFF */
    for (i=0; i< 20000; i++) /* delay for 20000 counts */
    {
        wait (); /* call wait function */
    }
    pPD = pPD | 0x10; /* output over PD port to LED D3 */
    /* bit 1 of port PD = LED D3 = ON */
    for (i=0; i< 40000; i++) /* delay for 40000 counts */
    {
        wait(); /* call wait function */
    }
}

```

This will change the LED on/off ratio.

3.3 Saving the Modifications

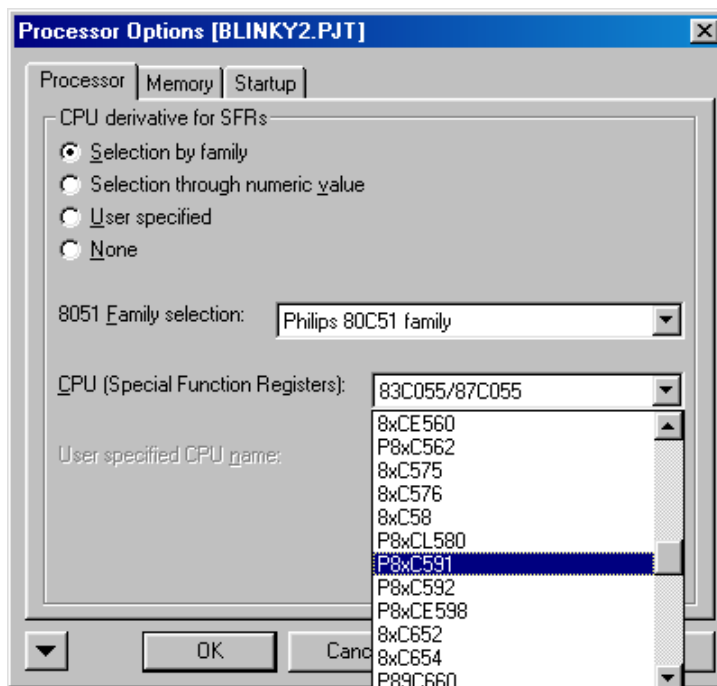
- Save the modified file by choosing *File/Save* or by clicking the floppy disk icon  .

3.4 Setting Tool Chain Options

Tasking EDE for 8051 includes a Make utility that can control compiling and linking source files in several programming languages. Before using the macro preprocessor, assembler, C compiler or linker/locator you must configure the corresponding options. Enter the changes as indicated below and leave all other options set to their default values. EDE allows you to set various options with mouse clicks and these are all saved in your project file.

To configure the CPU:

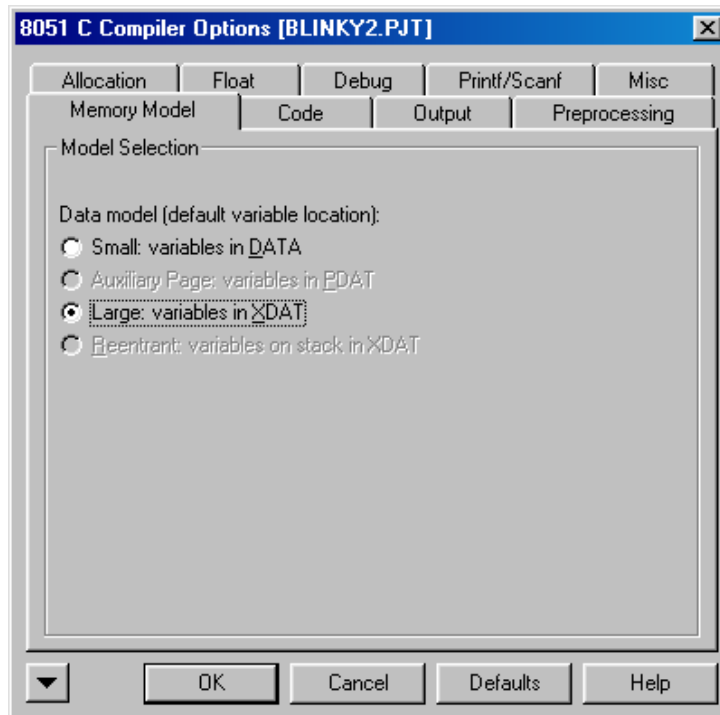
- Open the *EDE\Processor Options* menu from the EDE menu bar.



- Activate the radio button *Selection by family*. Choose the *Philips 80C51 family* in the *8051 Family selection* pull-down menu. In the pull-down menu *CPU*, select the *P8xC591* controller and click on **OK** to save these settings.

To configure the CC51 Compiler:

- Open the *EDE\C Compiler Options\Project Options* menu from the EDE menu bar.



- Select the radio button *Large: variables in XDAT* within the *Memory Model* tab and click on **OK** to save these settings.

To configure the MPP51 Macro Preprocessor:

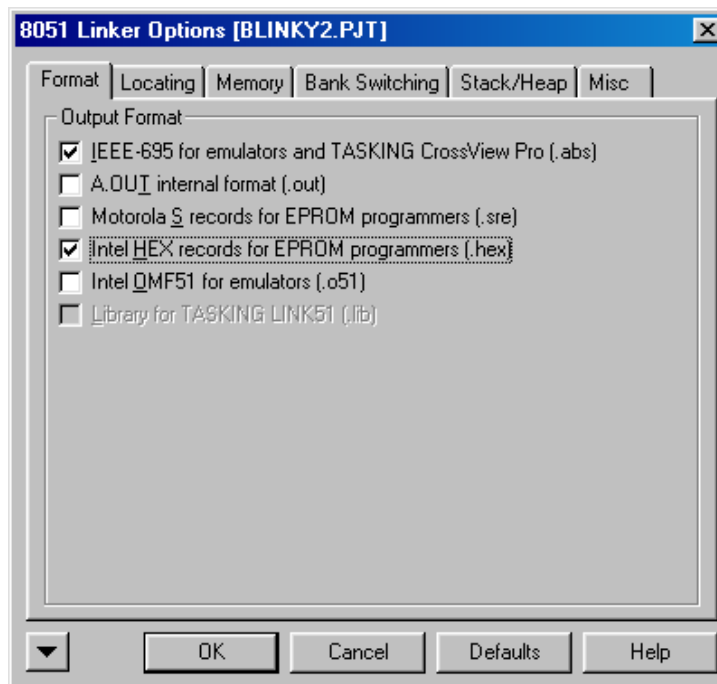
No modifications are necessary when default settings are used.

To configure the ASM51 Assembler:

No modifications are necessary when default settings are used.

To configure the LINK51 Linker:


- Open the *EDE\Linker Options* menu from the EDE menu bar.
- Activate the *Intel HEX records for EPROM programmers* checkbox.

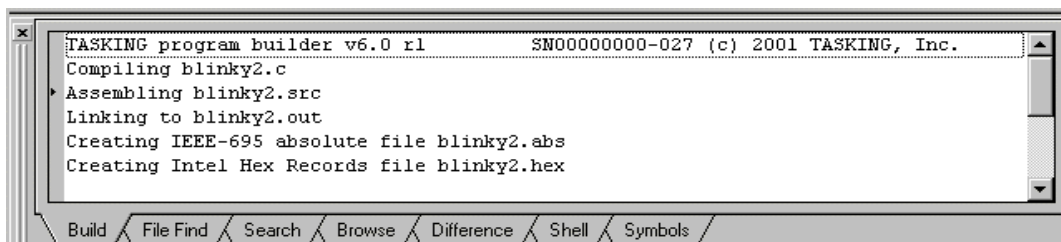


- Click on **OK** to save these settings.

3.5 Building the Project

You are now ready to run the compiler and linker using the Make utility.

- Click on the *Execute 'Rebuild' Command*  icon from the EDE tool bar or open the **Project** menu and select *Rebuild*. If the program specified (*Blinky2.c*) contains any errors, they will be shown in the **Output** window at the bottom of the screen.
- If there are no errors, the code is assembled and linked and the executable code is ready to be downloaded to the module. This is shown in the bottom line (status bar), which indicates *No errors found*. The created hexfile will have the name of the project with *.hex* as the filename extension (in this case *Blinky2.hex*).



```

TASKING program builder v6.0 r1      SM000000000-027 (c) 2001 TASKING, Inc.
Compiling blinky2.c
Assembling blinky2.src
Linking to blinky2.out
Creating IEEE-695 absolute file blinky2.abs
Creating Intel Hex Records file blinky2.hex
  
```

Note:

A machine-readable, executable hexfile has been created. Other files (e.g. assembler input files **.src*, list files **.lst* and map files **.map*) are generated to help the debugging or troubleshooting and error searching process.

- If a list of errors appears, use the editor to correct the error(s) in the source code and (re-)build the project again.

If you received an environment memory error message during the make process you must change the properties of your *command.com* file. Go to *Windows\Command.com*, right-click on the file and open the properties window. In the memory tab you must change the initial environment to 4096.

3.6 Downloading the Output File

- Exit Tasking EDE for 8051.
- Reset the target hardware and force it into Flash programming mode by simultaneously pressing the Reset (S2) and Boot (S1) buttons on the phyCORE Development Board LD 5V and then releasing first the Reset and, two or three seconds later, the Boot button.
- Start FlashTools98.
- At the *Communication Setup* tab of the FlashTools98 tabsheet, specify the proper serial port and transmission speed (9,600 Baud) for communication between host-PC and target hardware and click the *Connect* button to establish connection to the target hardware.
- Returning to the FlashTools98 tabsheet, choose the *Bank Utilities* tab, highlight *Bank #1* within the *Bank Erase* section, and click on the *Erase Bank(s)* button to erase this memory bank.
- Wait until the status check in the lower left corner of the FlashTools98 tabsheet finishes, returning the connection properties description to the lower left corner of the window.
- Next choose the *File Download* tab and click on the *File Open* button.
- Browse to the correct drive and path for the phyCORE-P87C591 Demo folder (default location **C:\PHYBasic\pC-P87C591\Demos\Tasking\Blinky2\Blinky2.hex** and click *Open*.
- Click on the *Download* button and view the download procedure in the status window.
- Returning to the *Communication* tab, click on the *Disconnect* button and exit FlashTools98.
- Press the Reset button (S2) on the Development Board.

If the modified hexfile properly executes, the LED should now flash in a different mode with different on and off durations.

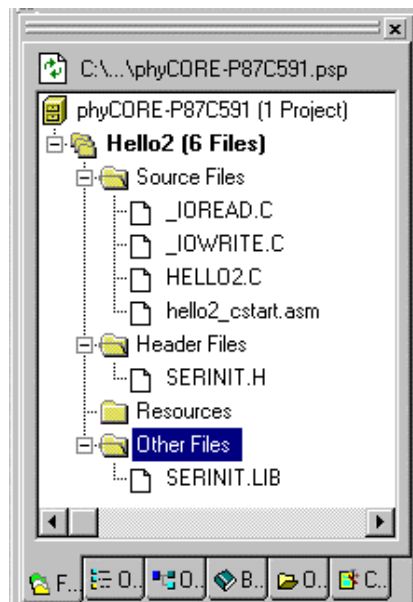
You have now modified source code, recompiled the code, created a modified downloadable hexfile, and successfully executed this modified code.

3.7 “Hello2”

A return to the “Hello” program allows a review of how to modify source code, create and build a new project, and download the resulting output file from the host-PC to the target hardware. For detailed commentary on each step, described below in concise form, refer back to the “Blinky2” example starting at section 3.1.

3.7.1 Creating a New Project

- Start the Tasking EDE environment and close all projects that might be open.
- Open the **Project** menu and create a new project space called phyCORE-P87C591 and a new project called **hello2** within the existing project folder
C:\PHYBasic\pC-P87C591\Tasking\Demos\Hello2
(default location) on your hard-drive.
- Add *serinit.lib*, *serinit.h*, *_ioread.c*, *_iowrite.c* and *hello2.c* from within the project folder to the project **hello2** (refer to section 3.2).
- Your **Project** window should now look like this:



- Save the project.

At this point you have created a project called ***Hello2.pjt*** consisting of the following source and library files:

- ***Hello2.c*** – demo program in C
- ***Serinit.lib*** – library of functions for initialization of the serial port
- ***_ioread.c* and *_iowrite.c*** – modified functions of the standard Tasking library to activate the *printf* and *scanf* functions to allow use of the terminal program without the debugger
- ***Hello2_cstart.asm*** – assembler program to define specific module configurations (automatically created and updated by the EDE)

3.7.2 Modifying the Example Source

- Double-click on the file ***Hello2.c*** from within the project window.
- Use the editor to modify the *printf* command:

```
printf ("\x1AHello World\n")  
  
to  
  
printf ("\x1APHYTEC... Stick It In!\n")
```

- Save the modified file under the same name ***Hello2.c***.

3.7.3 Setting Tool Chain Options

- Change the tool chain options default settings to the correct values as shown in *section 3.4*. This includes settings for the CPU, the memory model (make sure “*Large: variables in XDAT*” is configured) and the linker options (*Intel HEX records for EPROM programmers* checkbox active).
- In the ***EDE/C Compiler Options\Project Options\Preprocessing*** tab, define the user macro ***_NOSIMIO*** (no simulated output).

This define allows the *printf* and *scanf* functions to be used by direct executable applications for communication with a terminal program. Otherwise the functions for serial communication would need a simulator/debugger.

3.7.4 Building the New Project

- Build the project.
- If any source file in the project contains errors, they will be shown in an error dialog box on the screen. Use the editor to correct the error(s) in the source code, save the file and (re-)build the project.


If there are no errors, the code is assembled and linked and the executable code is ready to be downloaded to the board.

3.7.5 Downloading the Output File

- Exit Tasking EDE for 8051.
- Reset the target hardware and force it into Flash programming mode by simultaneously pressing the Reset (S2) and Boot (S1) buttons on the phyCORE Development Board LD 5V and then releasing first the Reset and, two or three seconds later, the Boot button.
- Start FlashTools98.
- At the *Communication Setup* tab of the FlashTools98 tabsheet, specify the proper serial port and transmission speed (9,600 Baud) for communication between host-PC and target hardware and click the *Connect* button to establish connection to the target hardware.
- Returning to the FlashTools98 tabsheet, choose the *Bank Utilities* tab, highlight *Bank #1* within the *Bank Erase* section, and click on the *Erase Bank(s)* button to erase this memory bank.
- Wait until the status check in the lower left corner of the FlashTools98 tabsheet finishes, returning the connection properties description to the lower left corner of the window.
- Next choose the *File Download* tab and click on the *File Open* button.
- Browse to the correct drive and path for the phyCORE-P87C591 demo folder (default location
C:\PHYBasic\pC-P87C591\Demos\Tasking\Hello2\Hello2.hex
directory).

- Click on the *Download* button and view the download procedure in the status window.
- Returning to the *Communication* tabsheet, click on the *Disconnect* button and exit FlashTools98.

3.7.6 Starting the Terminal Emulation Program

- Start HyperTerminal and connect to the target hardware using the following COM parameters: Bits per second = *9600*; Data bits = *8*; Parity = *None*; Stop Bits = *1*; Flow Control = *None*.
- Resetting the phyCORE Development Board LD 5V (at S2) will execute the ***Hello2.hex*** file loaded into the Flash.
- Now push the <Space> bar on your keyboard once to start the automatic baud rate detection on phyCORE-P87C591 module.
- Successful execution will send the modified character string "**PHYTEC... Stick It In!**" to the HyperTerminal window.
- Click the Disconnect icon .
- Close the Hyper Terminal program.

You have now modified source code, recompiled the code, created a downloadable hexfile, and successfully executed this modified code.

4 Debugging

This Debugging section provides a basic introduction to the debug functions included in the Tasking EDE for 8051 tool chain. Using an existing example, the more important features are described. For a more detailed description of the debugging features, *please refer to the appropriate manuals provided by Tasking.*

The Tasking EDE for 8051 Debugger offers two operating modes:

- The **CrossView Pro Simulator** allows PC-based microcontroller simulation of most features of the 8051 microcontroller family without actually having target hardware. You can test and debug your embedded application before the hardware is ready.
- The **CrossView Pro ROM Monitor** debugger allows for target hardware-based debugging. The debug environment on the PC communicates with the target hardware via a monitor kernel that is running on the target system. Debugging on the target hardware also enables testing peripheral components of the application.

The following examples utilize the CrossView Pro ROM Monitor debugger environment.

Note:

Use of the monitor program requires protection (reservation) of some controller resources, such as the serial interface, the serial interrupt and timer 1. These resources are necessary to allow communication between the monitor program on the target hardware and the CrossView Pro ROM Monitor debugger environment. Do not use these resources when developing an application program to be debugged using the Tasking ROM monitor interface.

Before using the Tasking ROM monitor interface, a special ***.hex** file (the monitor firmware) must be downloaded to the target hardware.

4.1 Preparing the Target Hardware to Communicate with CrossView Pro

- Ensure that the target hardware is properly connected to the host-PC and a power supply.
- Reset the target hardware and force it into Flash programming mode by simultaneously pressing the Reset (S1) and Boot (S2) buttons on the Development Board and then releasing first the Reset and, two or three seconds later, the Boot button.
- Start FlashTools98 for Windows.
- At the *Serial Interface* tab of the FlashTools98 tabsheet, specify the proper serial port and transmission speed for communication between host-PC and target hardware and click the *Connect* button to establish connection to the target hardware.
- Returning to the FlashTools98 tabsheet, choose the *Bank Utilities* tab, highlight *Banks #1* and click on the *Erase Bank(s)* button.
- Next choose the *File Download* tab and click on the *File Open* button.
- Download the file *pmm591.hex* from the *Tools* folder *C:\PHYBasic\pC-P87C591\Tools\Tasking\Mon\64k* (default location).

Note:

A specific monitor program has been made for each PHYTEC target hardware. Do not use a monitor program for another target module or processor.

- Click on the *Download* button and view the download procedure in the status window.

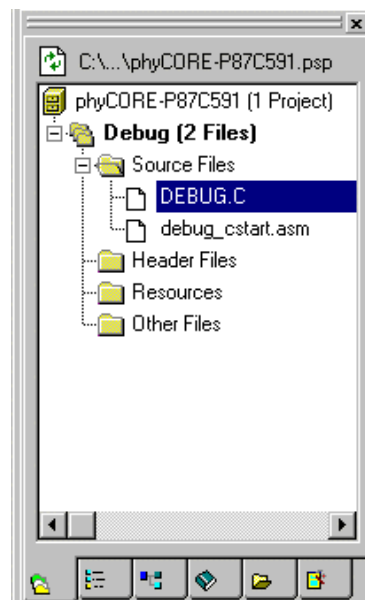
If the download was successful, the monitor kernel has been programmed into the external Flash memory. The target hardware is now prepared to communicate with the CrossView Pro ROM Monitor debugger environment installed on the host-PC.

- Disconnect from the target hardware after the download has finished, either by clicking the *Disconnect* button on the *Communication Setup* tabsheet or choosing the *Connect/Disconnect* icon from the FlashTools98 toolbar.
- Exit FlashTools98.

4.2 Creating a Debug Project and Preparing the Debugger

4.2.1 Creating a New Project

- Start the Tasking EDE for 8051 environment and close all projects that might be open.
- Open the *Project* menu and create a new project space called *phyCORE-P87C591* and a new project called *Debug* within the existing project directory
C:\PHYBasic\pC-P87C591\Demos\Tasking\Debug
(default location) on your hard drive.
- Add *Debug.c* from within the project folder to the project *Debug* (see to section 3.2).
- Your *Project* window should now look like this.



- *Save* the project.

At this point you have created a project called ***Debug.pjt*** consisting of the following source files:

- ***Debug.c*** – debug program in C
- ***Debug_cstart.asm*** – assembler program to define specific module configurations (automatically created and updated by the EDE)

4.3 Setting Options for Target

When setting the memory configuration, the memory layout necessary for the monitor must be considered.

A standard 8051 controller uses a Harvard memory architecture. In this architecture, access to CODE and XDATA memory space goes to physically different memory devices. Normally, for access to CODE space, a non-volatile memory is utilized, i.e. ROM or Flash. And for access to XDATA space, RAM is used. Using this memory model with an 8051 derivative allows addressing of up to 64 kByte of memory for CODE and 64 kByte for XDATA.

When debugging with the CrossView Pro ROM Monitor debugger environment, it is important that the user program (CODE) can be changed during runtime (e.g. to enable setting of breakpoints). This requires the user program to be stored in RAM and **not** in Flash. In order to ensure that the user program is running in RAM, the monitor automatically configures a von Neumann memory architecture. Here, in contrast to the Harvard architecture, access to CODE and XDATA space is directed towards the same physical memory device, normally RAM. With this von Neumann memory architecture, it is now possible to change the application program during runtime.

The following figure (see Figure 4) depicts the memory layout that is configured by the Tasking ROM monitor for 32 kByte RAM.

The SRAM on the phyCORE-P87C591 is mapped to address range 0000H bis 7FFFH. This memory space can be accessed with both read and write commands. The address range from 8000H up to FBFFH is reserved and can not be used. The on-board address decoder with its three I/O Chip Select signals is located in the address range FC00H to FFFFH.

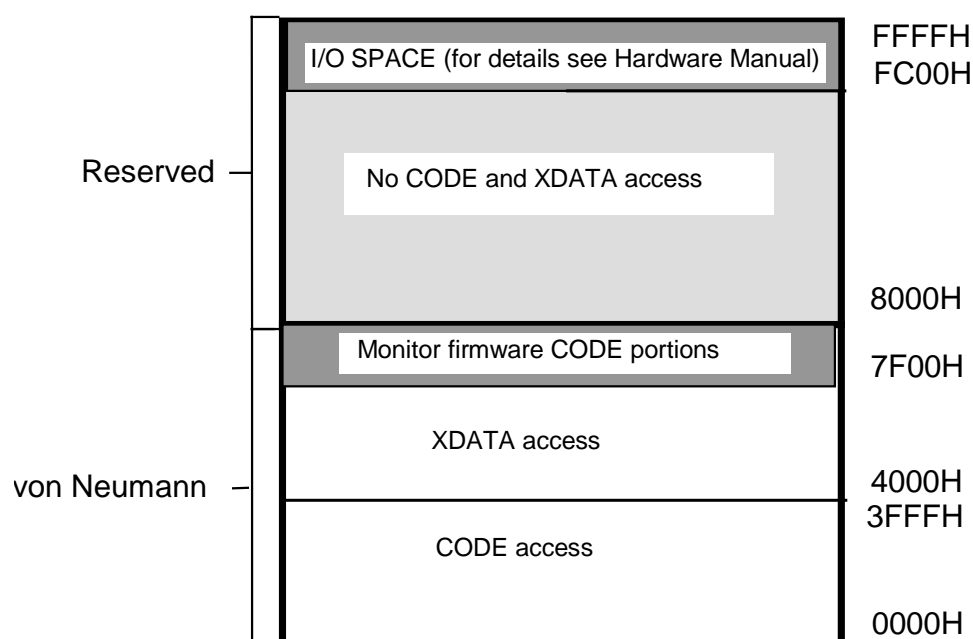


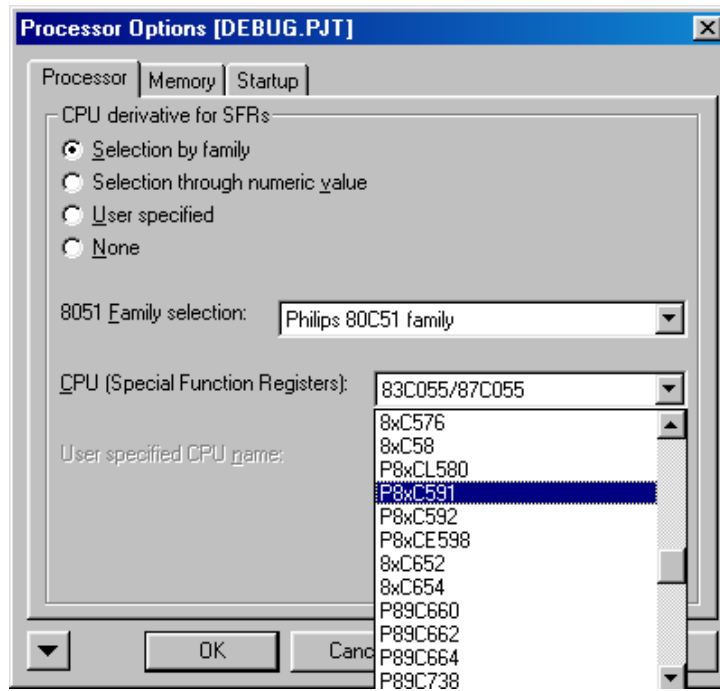
Figure 4: Memory Model for Use with the Tasking ROM Monitor (32 kByte RAM)

Note:

When using the von Neumann memory architecture, ensure that the CODE and XDATA areas within the application program do **not** overlap. This is important because otherwise portions of the program (CODE) will be overwritten by e.g. variables (XDATA), resulting in an error when executing user code.

To configure the CPU:

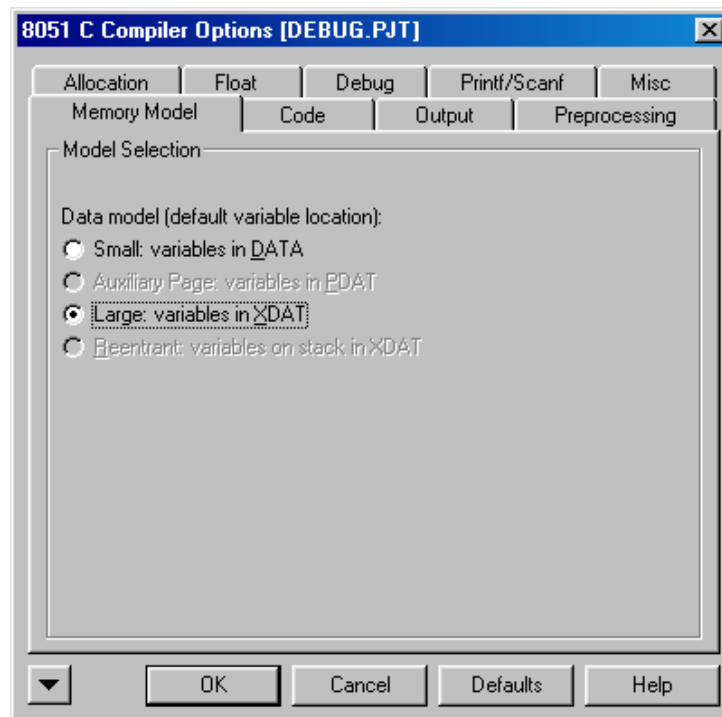
- Open the **EDE/Processor Options...** menu to configure the processor options for the **Debug** project:
- Activate the radio button **Selection by family**. Choose the **Philips 80C51 family** in the **8051 Family selection** pull-down menu. In the pull-down menu **CPU**, select the **P8xC591** controller.



- Click on **OK** to save these settings.

To configure the CC51 Compiler:

- Open the *EDE\C Compiler Options\Project Options* menu from the EDE task bar.
- Select the radio button *Large: variables in XDAT* within the *Memory Model* tab.



- Click the *OK* button to save the settings

To configure the Safer C Compiler Options:

No modifications are necessary when default settings are used.

To configure the ASM51 Assembler:

No modifications are necessary when default settings are used.

To configure the LINK51 Linker:

- Open the *EDE\Linker Options...* menu from the EDE tool bar and select the *Memory* tabsheet.

- In the text field *Reserved CODE memory* enter the values **023H,025H** and **04000H,0FFFFH**. Separate both ranges with a semicolon “;”. These address areas are reserved for:

23H-025H	monitor interrupts
4000H-7EFFH	XDATA application program
7F00H-7FFFH	CODE monitor program
8000H-FBFFH	reserved memory
FC00H-FFFFH	I/O area of the phyCORE-P87C591

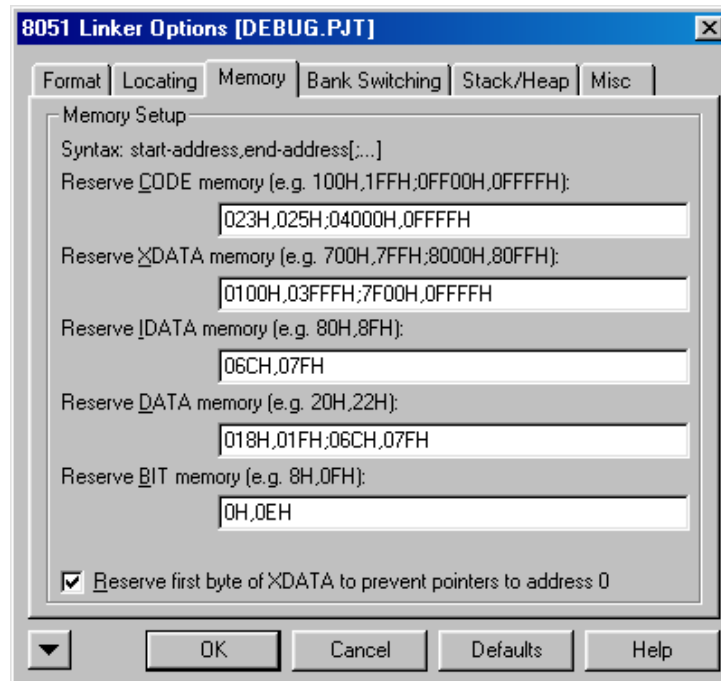
- In the text field *Reserved XDATA memory* enter the values **0H,03FFFH** and **07F00H,0FFFFH**. Separate both ranges with a semicolon “;”. These address areas are reserved for:

0H-3FFFH	CODE application program and monitor interrupts
7F00H-7FFFH	CODE monitor program
8000H-FBFFH	reserved memory
FC00H-FFFFH	I/O area of the phyCORE-P87C591

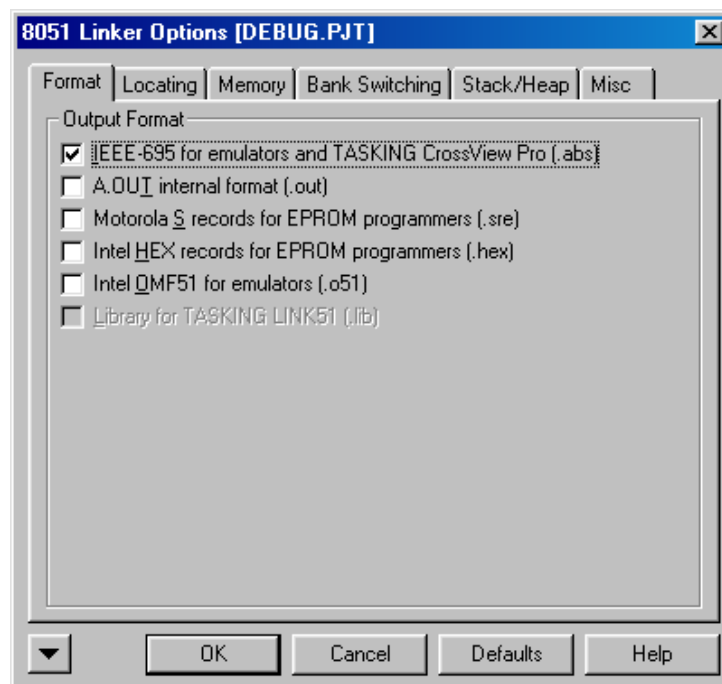
- In the text field *Reserved IDATA memory* enter the values **06CH,07FH**. This address area is reserved for the monitor program.

- In the text field *Reserved DATA memory* enter the values **018H,01FH** and **06CH,07FH**. Separate both ranges with a semicolon “;”. These address areas are reserved for the monitor program.

- In the text field *Reserved BIT memory* enter the values **0H,0EH**. This address area is reserved for the monitor program.




- In the *EDE\Linker Options...* menu, select the *Format* tabsheet.
- Activate the *IEEE-695 for emulators and Tasking CrossView Pro (.abs)* checkbox.



- Click the *OK* button to save the settings.

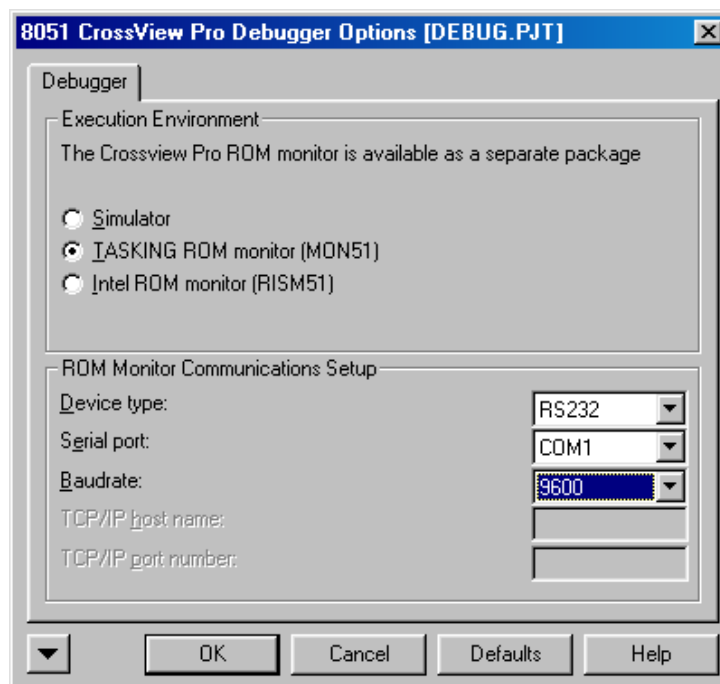
Build the Project:

- Click on the *Execute 'Rebuild' Command*  icon at the EDE tool bar or open the **Project** menu and select **Rebuild**.
- If any source file in the project contains errors, they will be shown in an error dialog box on the screen. Use the editor to correct the error(s) in the source code, save the file and (re-)build the project.

If there are no errors, the code is assembled and linked and the code can now be debugged using the CrossView Pro debug environment.


4.4 Preparing the Debugger

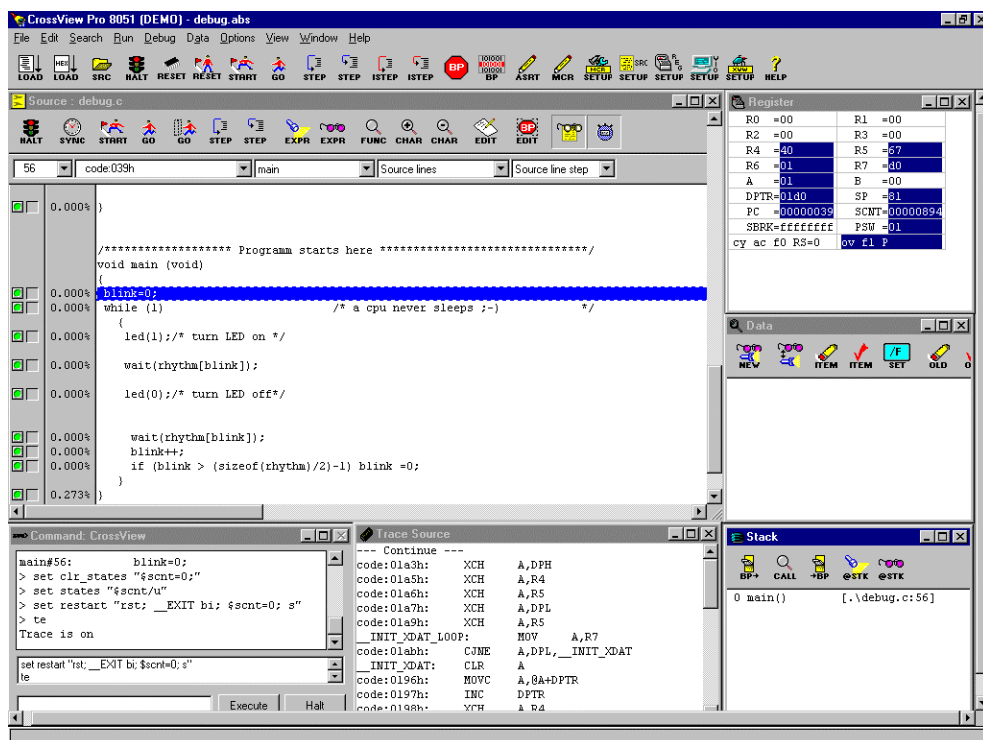
- Open the *EDE\CrossViewPro_Options* menu from the EDE tool bar.
- In the **Debugger** tabsheet, select the radio button *Tasking ROM monitor (MON51)* and specify the correct COM port and baud rate in the *ROM Monitor Communication Setup* as shown below.



- Click on the **OK** button to save the settings.

4.5 Starting the Debugger

- Before starting the CrossView Pro Debugger on the host-PC, press the Reset button (S1) on the phyCORE Development Board LD 5V to start the previously downloaded monitor kernel.
- To start the Tasking debug environment, click on the debugger icon  on the EDE toolbar.
- The CrossView Pro debugger will open the project (.abs file) and download the code to the target board. The debugger automatically performs a *go-to-main* action which executes the startup code.
- If the data transfer was successful, a **CrossView Pro** screen similar to the one shown below will appear:



The window marked “Source: debug.c” is the Debug window. The *Command: CrossView* window can be used to enter commands. You may need to open, resize and /or move some windows to make your screen look similar to the screen capture. You can open inactive windows by choosing the desired window from the *View* pull-down menu.

4.6 Tasking CrossView Pro Debug Features

The CrossView Pro Debug environment provides a variety of commands supporting easy code debugging. The following section gives a short overview of some important debug commands:



The *Reset* command sets the program counter to 0. However, it should be noted that peripherals and SFRs of 8051 devices are not set into reset state. Therefore this command is not identical to a hardware reset of the CPU.



Clicking this button *Continue execution (same as F5)* runs the program without active debug functions. To stop program execution at a desired point, a breakpoint can be placed before the *Continue execution* button is pushed.



The *Run to cursor (same as F7)* command executes the program to the current cursor position within the code window. This allows use of the cursor line as a temporary breakpoint.



The *Halt* button interrupts and stops the running program at an undetermined location.



CrossView Pro uses *Step (into function calls)* to single step one instruction at a time. The *Step (into function calls)* command is also used to access a subroutine or function.



The *Step (over function calls)* command allows to execute a command line without single stepping into the function.



The *Show selected source expression* command displays the current value of a variable.



The *Watch selected source expression* command is used to display the value of a variable with its immediate updates.

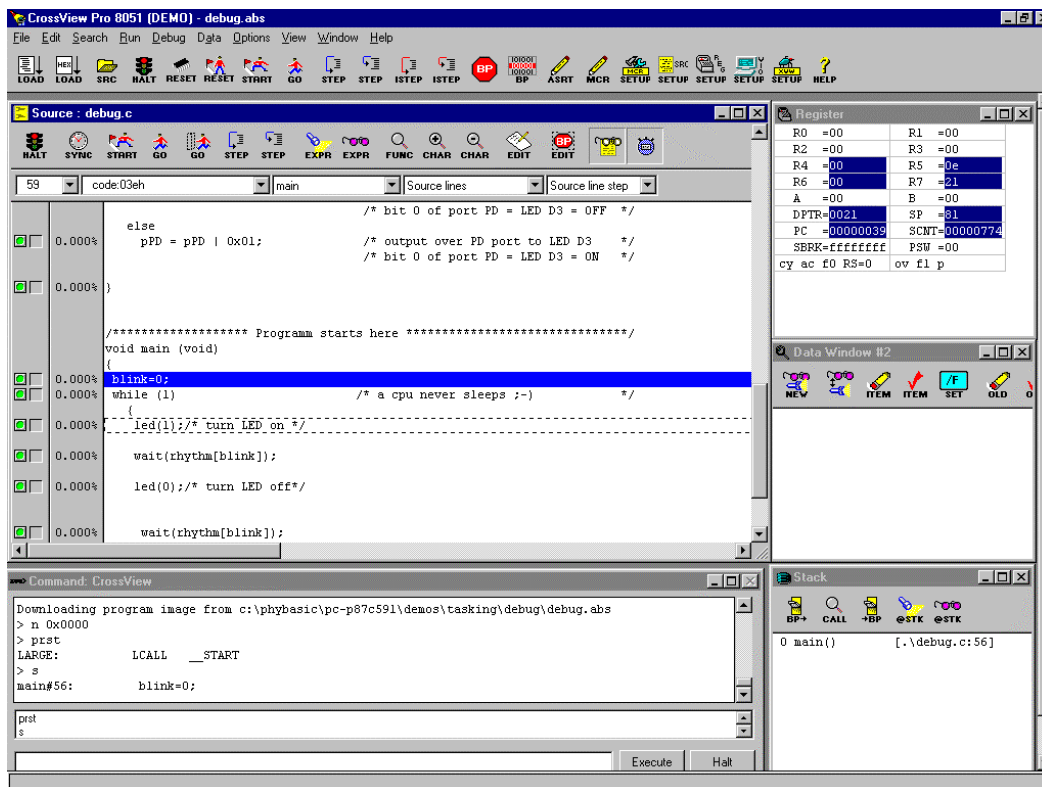
4.7 Using the Tasking CrossView Pro Debug Features

The following section describes the use of specific functions within the CrossView Pro debug environment in conjunction with the *Debug* example code.

4.7.1 Single Stepping and Watch Window

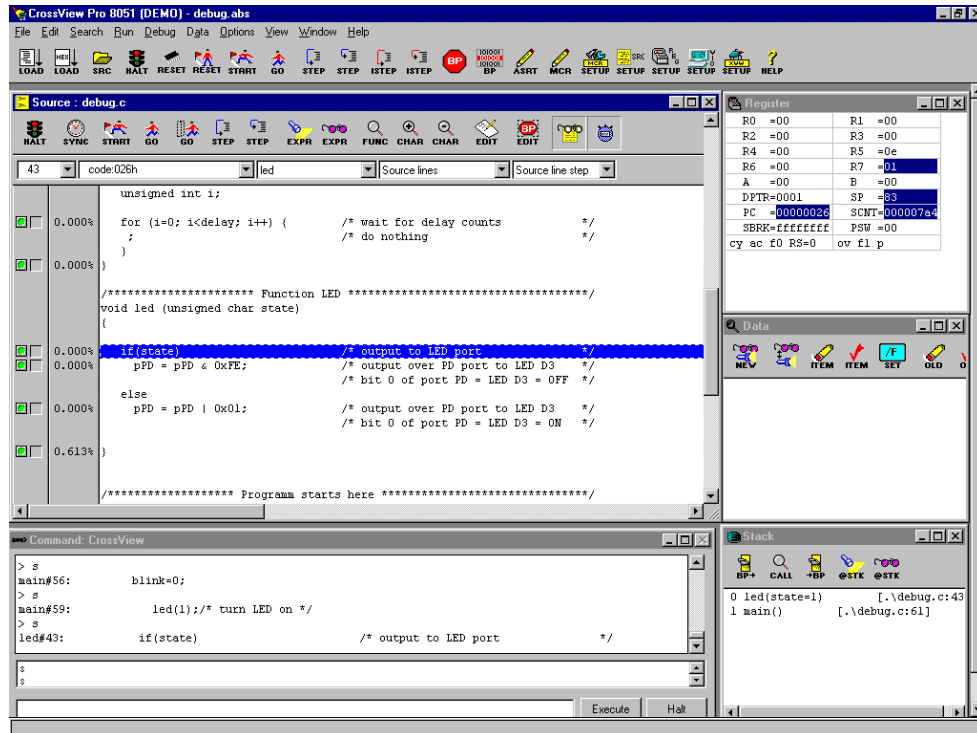
Run to cursor (F7)

- Click in the source code line *led(1)*; of the Debug program and choose *Run to Cursor*. Your program will be executed until it reaches this line.



Step (into function calls)

- Click on the *Step (into function calls)* icon to enter the *'led(1)'* function.



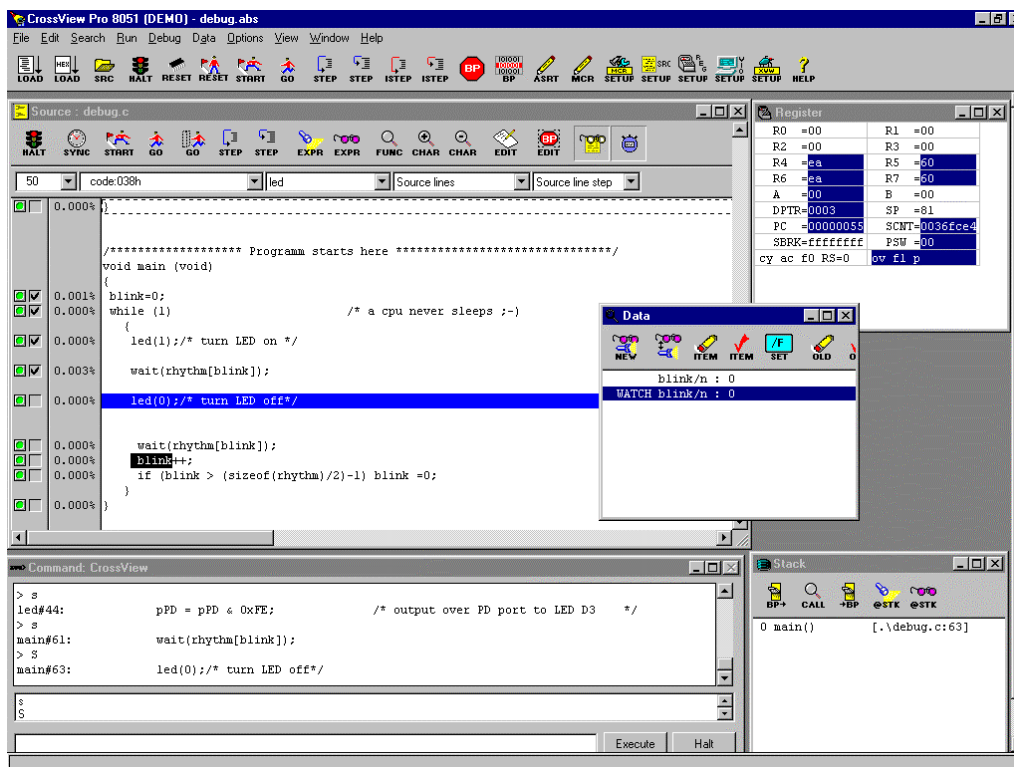
- Notice that the LED (D3) on the Development Board now illuminates. This is because the *led()* function call has been executed. Click on the *Step (into function calls)* icon twice to single step through this function.

Step (over function calls)

- Click on the *Step (over function calls)* icon to execute the *wait(rhythm[blink]);* function without entering it. All subroutines are executed immediately and not displayed in the debug window.

Show and Watch Expression

- The debug commands *Show selected source expression* and *Watch selected source expression* can be used to display the value of a variable. Select the variable "**Blink**" in the source code line `blink++;`.
- Click on the *Show selected source expression* icon. The current value "`blink/n : 0`" is now displayed in the **Data** window.
- Click on the *Watch selected source expression* icon. The current value "`Watch blink/n : 0`" is now displayed in the **Data** window.

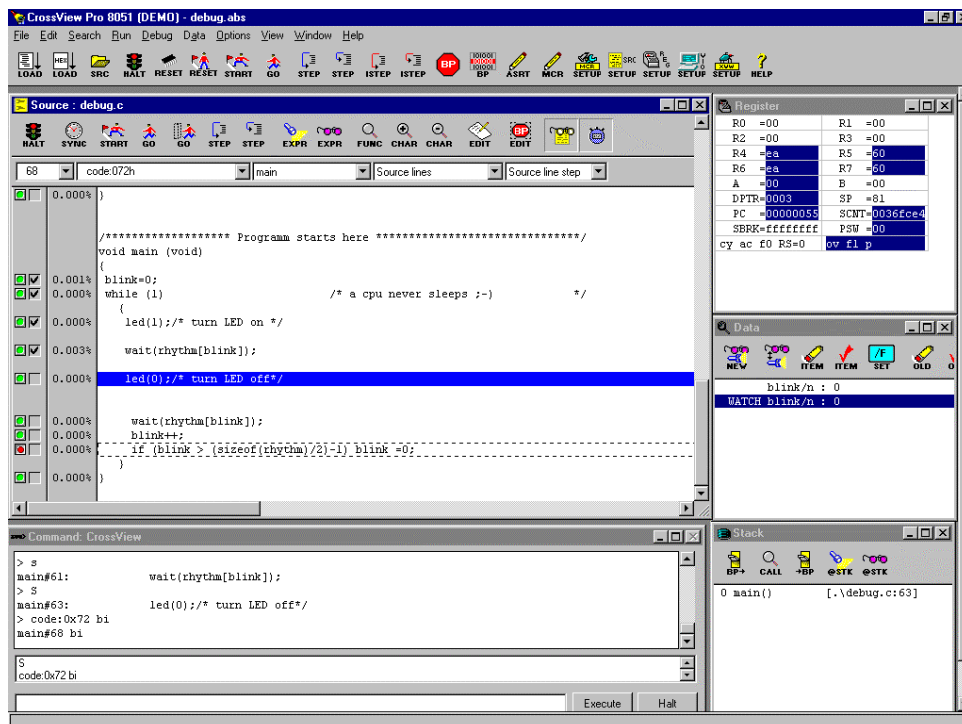



- Click in a different source code line in order to disable the selection of the variable "**Blink**".

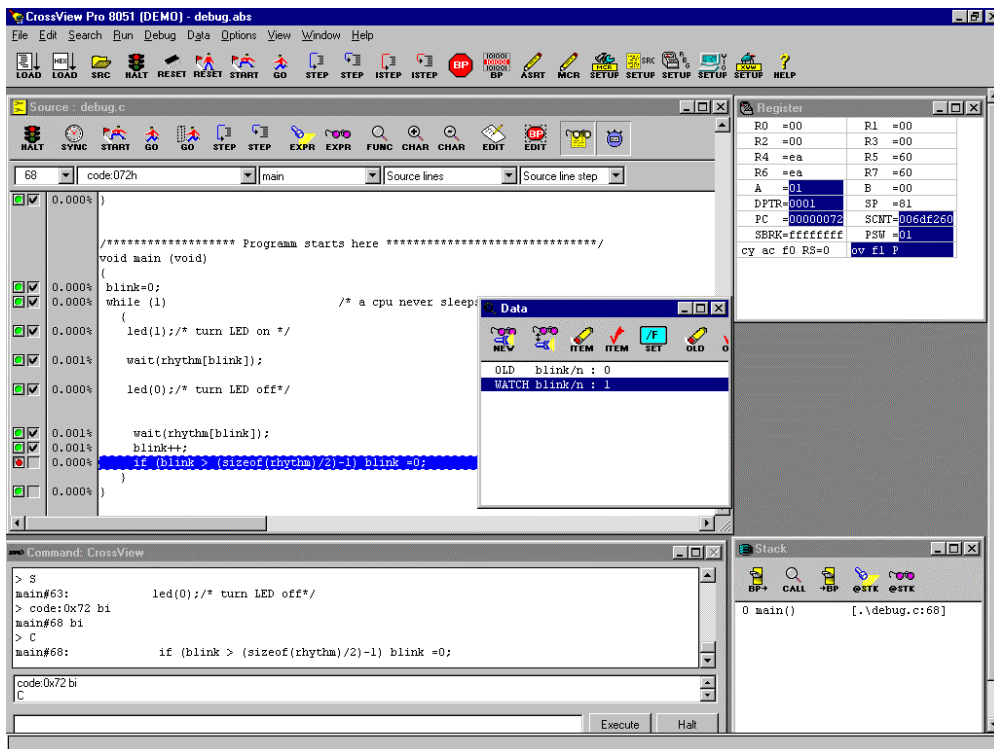
4.7.2 Breakpoints

In the *Source* window debug.c you will find a green button in front of each code line. You can insert a breakpoint to any desired code line by clicking on the green button.

- Click on the green button in the source code line “`if (blink > (sizeof (rhythm)/2)-1) blink = 0;`“. The green button will change to a red button which indicates a breakpoint has been inserted in this code line.



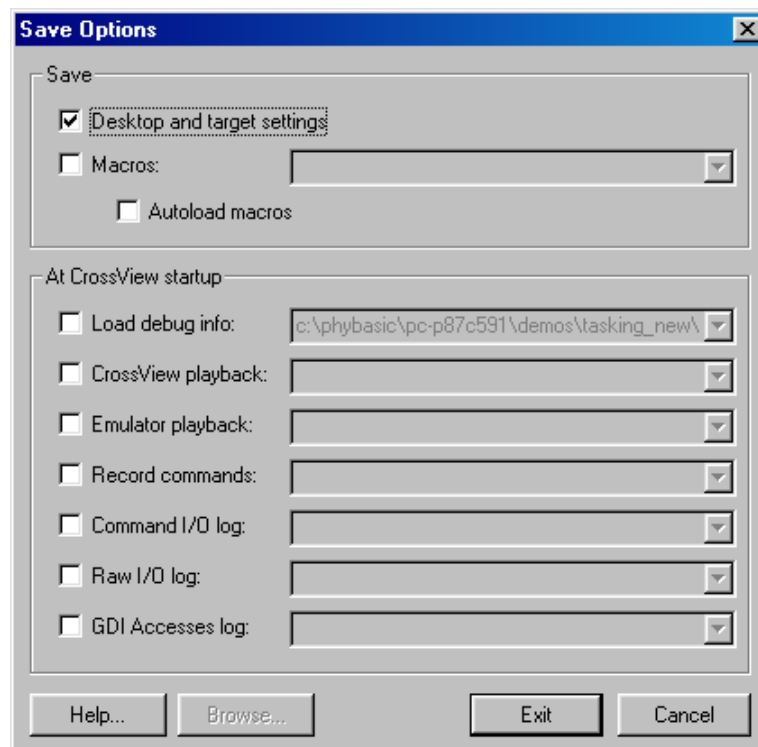
- Now click on the *Continue execution*  icon. The program will run and stop at the breakpoint.



- Notice the changes of the variable "**Blink**" in the *Data* window. The value of this variable is updated in the "Watch blink/n : " line while the "Show blink/n : " line only indicates that the value has changed by adding the prefix *OLD*. No update of the variable value is shown in this line.

4.7.3 Exiting CrossView Pro

- Open the *File\Exit* menu from the EDE tool bar to close the current CrossView Pro debug session.

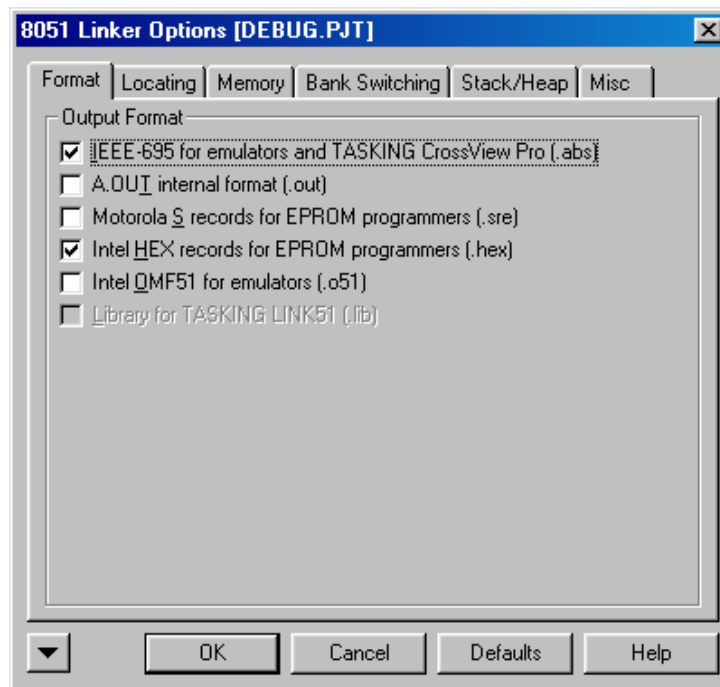



- Click on the *Exit* button in the *Save Option* menu to exit CrossView Pro.

4.8 Changing Target Settings for the "Final Version"

After successfully debugging the program, next change the target settings in order to create an Intel hexfile. This can then be downloaded to the Flash memory of the phyCORE-P87C591.

- Open the **EDE\Linker Options** menu from the EDE tool bar.



- Activate the *Intel HEX records for EPROM programmers* checkbox and click on **OK** to save these settings.
- Click on the *Execute 'Rebuild' Command*  icon at the EDE tool bar or open the **Project** menu and select **Rebuild**.
- Download the created **Debug.hex** file (located in **C:\PHYBasic\pC-P87C591\Demos\Tasking\Debug**) to the Flash memory. For general download procedure information refer to sections 2.2 through 2.4.
- Press the Reset button S2 on the Development Board to start the program.
- Now you can watch your final debug example execute. The program will flash the LED D3 with alternating on and off duration.

5 Advanced User Information

This section provides advanced information for successful operation of the phyCORE-591 with the Tasking tool chain.

5.1 FlashTools98

Flash is a highly functional means of storing nonvolatile-data. One of its advantages among many others is the possibility of on-board programming. Programming tools for the Flash device are always included with the phyCORE-P87C591 in the form of a pre-programmed Flash with a resident microcontroller firmware and a counterpart software serving as the user interface on a host-PC. Once the firmware communicates with the PC-based software, FlashTools98 allows the download of user code from the host-PC into the Flash. Additionally, the re-programmable Flash device on the phyCORE-P87C591 allows you to easily update your own code and the target application in which the phyCORE-P87C591 has been implemented.

Currently the phyCORE-P87C591 can be populated by two different sized Flash devices: a 29F010 with 128 kByte or a 29F040 with 512 kByte. To support the entire memory area of these devices the address decoder of the phyCORE-P87C591 is equipped with an integrated banking mechanism that allows code-bank switching in code-banks of 64 kByte each.

Please note that the FlashTools98 kernel always occupies the first 64 kByte bank (bank 0, FA[18..15] = 0000b) of the Flash memory. This bank is pre-programmed upon delivery of the phyCORE-P87C591. The remaining banks are available to house your application. This makes one user application bank available if the phyCORE-P87C591 is mounted with a 29F010 and seven user application banks if the phyCORE-P87C591 is mounted with a 29F040 Flash memory device. Multiple user application banks can easily be managed by using the Code Banking mechanism of the Tasking tool chain.

The following description is valid only for the FlashTools98 included with the phyCORE-P87C591 and is not intended as a guideline for using any other program.

FlashTools98 incorporates a safety mechanism that ensures that the system bank (bank 0), in which the firmware is resident, can not be overwritten during programming of the available user banks of the Flash device.

Resetting the phyCORE-P87C591 also activates the system bank (bank 0) of the Flash device, which automatically starts the FlashTools98 firmware. Then the firmware either enters the Flash programming mode or starts your user application.

To distinguish between download and execution modes, the firmware latches the /BOOT signal after reset (/BOOT=0 => start Flashtools, /BOOT=1 => start user program). This signal can be set to a low level by pressing the Boot (S1) button located on the phyCORE Development Board LD 5V. To enter the Flash programming mode you must simultaneously press the Reset (S2) and the Boot (S1) button, release the Reset (S2) button first and then, two to three seconds later, release the Boot (S1) button.

Execution of your user application will always start in the second 64 kByte bank (bank 1, FA[18..15] = 0010b). This is to be noted when preparing a software copy of the contents of the address decoder's internal write-only registers.

The extended features of the address decoder on the phyCORE-P87C591 allows flexibility when configuring the memory model according to your needs and addressing additional Flash banks.

Do not use Flash bank 0 in your application program in order to preserve the FlashTools98 microcontroller firmware and the associated Flash re-programming capability.

5.2 Cstart.asm

The code within the assembly file *Project_cstart.asm* initializes the target hardware for your C project. This includes setting of the system stack, initialization of variables and clearing of memory areas.

The *Project_cstart.asm* routines always start at code memory address 0x0000. This is where the reset vector with the jump instruction to the actual *Project_cstart.asm* initialization functions is located. Following a hardware or software reset, the microcontroller starts execution at address 0x0000 and then jumps to the start-up routines location configured by the reset vector. After performing the initialization steps, your individual *main()* function is called by the startup code.

The configuration of the startup code is done via macro preprocessor defines which are generated automatically by EDE according to the settings in *EDE/Processor Options*.

The *Project_cstart.asm* file is automatically generated every time a new project is created if the checkboxes *Generate Startup* und *Add startup code* are activate. These options are available in the *Startup* tabsheet accessible within the *EDE\Processor Options...* menu. If no *Project_cstart.asm* file is included in your project you can add the file *cstart.asm* which is located in the *\lib* folder within the Tasking installation directory.

5.3 Linking and Locating

The Linker must combine several relocatable object modules contained in object files and/or libraries to generate a single absolute object.

In addition, the linker must locate several segments of code and data to fixed address locations within the address space in regards to the memory types of the phyCORE-P87C591. XDAT segments always must be located to Random Access Memory (e.g. RAM), CODE segments should be located to non-volatile memory (e.g. Flash). The 8051 family supports a Harvard memory architecture that distinguishes between non-volatile and randomly accessible memory and has two physically different signals for separate fetching of data and code.

The Tasking tool chain distinguishes the following segment types:

- **CODE:** code
- **XDAT:** external data (max. 64 kByte)
- **DATA:** direct addressable on-chip data (max. 128 Byte)
- **IDATA:** indirect addressable on-chip data (max. 256 Byte)
- **BIT:** bit-addressable on-chip data (max. 128-bits)

The segment types DATA, IDATA and BIT always reside in the on-chip RAM of the controller.

The segment types XDAT and CODE will usually reside in external memory devices.

To ensure proper execution of your application, it is required that all XDAT segments are located to the external RAM of the phyCORE-P87C591 and that all CODE segments are located to the external Flash memory of the phyCORE-P87C591. Exceptions may occur if you use a 8051 derivative with on-chip portions of XDAT (e.g. internal XRAM) or CODE (e.g. internal ROM).

Since the phyCORE-P87C591 is equipped with a software configurable address decoder instead of simple programmable logic device, you can configure the memory model to your needs at runtime.

To ensure proper execution of your application, you must take the runtime memory model into consideration when linking and locating. This means that you must instruct the linker where to assume external RAM for locating data segments and Flash for locating code segments.

The standard configuration of the phyCORE-P87C591 is equipped with 128 kByte of external RAM and 128 kByte of external Flash. During runtime the RAM will be addressable at 0x0000 to 0xFFFF. The user bank (bank 1, FA[18..15] = 0010b) will be addressable at 0x0000 to 0xFFFF. This default runtime memory model requires no additional linker settings because both RAM and Flash start at 0x0000. This is also the default start address of the linker's segment types.

Since you can not define any end address, you should always ensure that the size of the segments fits within the available size of the mounted memory devices. For instance all XDAT segments should end below 0x7FFF if a 32 kByte RAM device is mounted on the phyCORE-P87C591. We recommend generation of a **.151* map file for your project and inspection of the memory map information within this file.

Whenever you modify the memory model (e.g. use von Neumann rather than Harvard memory), which leads to different start addresses of code or data memory, you must configure this in the linker settings.

Document: phyCORE-P87C591 QuickStart Instructions
Document number: L-472e_6, July 2002

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