

Development Kit DIPmodul 164

Quickstart Instructions

Edition December 2001

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1 Introduction to the Development Kit

This QuickStart provides:

- general information on the SYS TEC DIPmodul 164 Single Board Computer (SBC)
- an overview of Keil's μ Vision2 software evaluation development tool chain, and
- instructions on how to run example programs on the DIPmodul 164, mounted on the SYS TEC DIPmodul Development Board, in conjunction with Keil μ Vision2

Please refer to the DIPmodul 164 Hardware Manual for specific information on such board-level features as jumper configuration, memory mapping and pin layout.

1.1 Development Kit Documentation

The "Development Kit" includes the following electronic documentation on the enclosed SYS TEC Products CD-ROM:

- the SYS TEC DIPmodul 164 Hardware Manual and DIPmodul Development Board Hardware Manual
- controller User's Manual and Data Sheets
- this QuickStart Instruction with general "Development Kit" description, software installation hints and two example programs enabling quick out-of-the box start-up of the DIPmodul 164 in conjunction with the Keil μ Vision2 software development tools.

1.2 Overview of this Quickstart Instruction

This QuickStart Instruction gives a general “Development Kit” description, as well as software installation hints and two example programs enabling quick out-of-the box start-up of the DIPmodul 164 in conjunction with the Keil μ Vision2 software development tools. It is structured as follows:

- 1) The *"Getting Started"* section uses two example programs, *"Blinky"* and *"Hello"*, to demonstrate the download of user code to the Flash device using PHYTEC FlashTools for Windows.
- 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 DIPmodul 164 using the Keil tool chain and FlashTools.

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

1.3 System Requirements

Use of this “Development Kit” requires:

- the SYS TEC DIPmodul 164,
- the SYS TEC DIPmodul Development Board with included DB-9 serial cable and AC adapter supplying 8-13 VDC / min. 300 mA,
- the SYS TEC Products CD-ROM,
- an IBM-compatible host-PC (486 or higher running at least Windows 9x/NT)

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



<http://www.systec-electronic.de>
support@systec-electronic.de



<http://www.phytec.com>
support@phytec.com



<http://www.keil.com>
support@keil.com

1.4 The SYS TEC DIPmodul 164

The DIPmodul 164 represents an affordable, yet highly functional Single Board Computer (SBC) solution in DIP-40 dimensions (24 mm x 56 mm). The standard board is populated with an Infineon C164x controller in MQFP-80 packaging, featuring an 8-channel on-chip A/D-converter with 10-bit resolution and an integrated 2.0B CAN controller.

All applicable data/address lines and applicable signals extend from the underlying logic devices to two standard-width (2.54 mm /0.10 in.) single row SMD pin header connectors. This enables the DIPmodul 164 to be plugged like a “big chip” into target hardware.

The standard memory configuration of the DIPmodul 164 features 32 kByte external SRAM and 128 kByte external Flash. The Flash device allows direct on-board programming.

The module communicates by means of a serial communication channel and operates within a standard industrial range of 0 to +70 degrees C. It requires only a 80 mA power source.

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

DIPmodul 164 Technical Highlights

- SBC in DIP-40 dimensions (24 mm x 56 mm) achieved through state-of-the-art SMD technology
- populated with an MQFP-80 packaged Infineon C164x featuring 2.0B on-chip CAN
- 20 MHz CPU frequency, achieved through doubling the external quartz frequency
- improved interference safety achieved through multilayer technology
- 128 kByte on-board Flash (up to 256 kByte Flash)¹ supporting on-board downloading of user code from a host-PC in conjunction with FlashTools
- 32 kByte (up to 256 kByte) on-board SRAM¹
- 2 kByte (up to 128 kByte) serial EEPROM¹
- serial interface (TTL level)
- 2.0B CAN bus interface supporting 11-bit and 29-bit message identifiers with on-board CAN transceiver
- on-chip Bootstrap loader
- various port lines are available on the pin header connector (DIPmodul-connector)
- on-chip Real-Time Clock
- can be plugged into the application like a “big chip”
- requires only a +5 VDC / 80 mA (max.) power source

¹: Contact SYS TEC/PHYTEC for additional memory configurations.

The SYS TEC DIPmodul Development Board, 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 SYS TEC DIPmodul series Single Board Computers with standard width DIP-40 (2.54 mm/ 0.10 in.) pin header connectors. Simple jumper configuration readies the Development Board's connection to any DIPmodul, which plug pins-down into the contact strips mounted on the DIPmodul Development Board.

DIPmodul Development Board 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
- a low voltage socket and voltage regulator accepting an unregulated input voltage in a range from 8 to 13 VDC
- one DB-9 socket configured as RS-232 interface
- one DB-9 plug configured as a CAN interface
- simple jumper configuration allowing use of the DIPmodul Development Board with various SYS TEC DIPmodul SBCs
- peripheral devices (4 push buttons, 4 LEDs, 2 potentiometers) for quick testing of user software
- a wire wrap field (80 mm x 40 mm) supporting development of user-designed peripheral hardware
- 1 x 160-pin Molex connector (X200) enabling easy connectivity to expansion boards (e.g. PHYTEC mini-IO Expansion Board)

1.5 The Keil Software Evaluation Development Toolchain

The Keil μ Vision2 software evaluation development tool chain fully supports the entire Infineon C166 microcontroller family. This includes a C compiler, macroassembler, linker/locator, the simulator and target monitor within the μ Vision2 IDE.

μ Vision2 supports all in-circuit emulators that to the Infineon OMF166 debugging specification. The Keil OH166 object-to-hex converter converts an absolute object file into an Intel-hexfile that is suitable for programming into the on-board Flash on the SYS TEC DIPmodul 164.

The Keil μ Vision2 tool chain consists of the following executables:

- **C Compiler** c166.exe
- **Assembler** a166.exe (macroassembler)
- **Linker** l166.exe (linker/locator)
- **Converter** oh166.exe (object-to-hex converter)
- **μ Vision2** uv2.exe (a Windows based applikation)

Once installed, the default destination location for the DOS-based files is the **C:\Keil\C166\Bin** directory while μ Vision2 is in **C:\Keil\Uv2**. Access to these programs from Windows is accomplished within μ Vision2. The entire tool set can be run from μ Vision2 or directly from DOS with batch files. The evaluation version of the Keil tool chain is restricted to a manipulable code size of 4 kByte. Other than these restrictions, the evaluation tool chain functions exactly as the full version does, enabling full evaluation of the features and functionality of Keil development tools. The full version has no such restrictions, both are fully ANSI compliant.

µVision2 IDE

µVision2 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. µVision2 runs under Windows 95/98/ME/NT and 2000. This Integrated Development Environment (IDE) has been expressly designed with the user in mind and includes a fully functional editor.

All IDE commands and functions are accessible via intuitive pull-down menus with prompted selections. An extensive Help utility is included. External executables can be run from within µVision2, including emulator software.

C166 C Compiler

The C166 ANSI compiler and A166 assembler are designed specially for the Infineon C16x and future derivatives. The C166 compiler easily integrates into the Keil RTOS and interfaces and passes debug information to the µVision2 Simulator and all in-circuit emulators. Extensions provide access to onchip peripherals. The Keil C166 compiler provides the fastest and smallest code using industry benchmarks.

A166 Macro Assembler

The professional Kit (PK) macroassembler is included with the PK Compiler package or is available separately. It is DOS based or can be run from µVision2 and includes all utilities needed to complete your project.

Debug Environment

µVision2 contains a software simulator supporting either via software on a host-PC or in target hardware. When operated in conjunction with Keil Monitor resident in target hardware µVision2 enable the following debugging functions:

- run/halt,
- set breakpoints,
- examine/change memory,
- view the stack,
- view/set peripheral information,
- apply virtual external signals.

µVision2 has a performance analysis feature to ensure your code runs efficiently. In addition, µVision2 has a disassembler/assembler that allows the modification of user code without recompiling.

2 Getting Started

What you will learn with this Getting Started example:

- installing Development Kit software
- starting PHYTEC FlashTools for Windows download utility
- interfacing the DIPmodul 164, mounted on the DIPmodul Development Board, to a host-PC
- downloading example user code in hexfile format from a host-PC to the external Flash memory using FlashTools

2.1 Installing Development Kit Software

The automatic installation of all required software components as well as electronic documentation for the DIPmodul 164 Development Kit is not yet finished. This will be available soon.

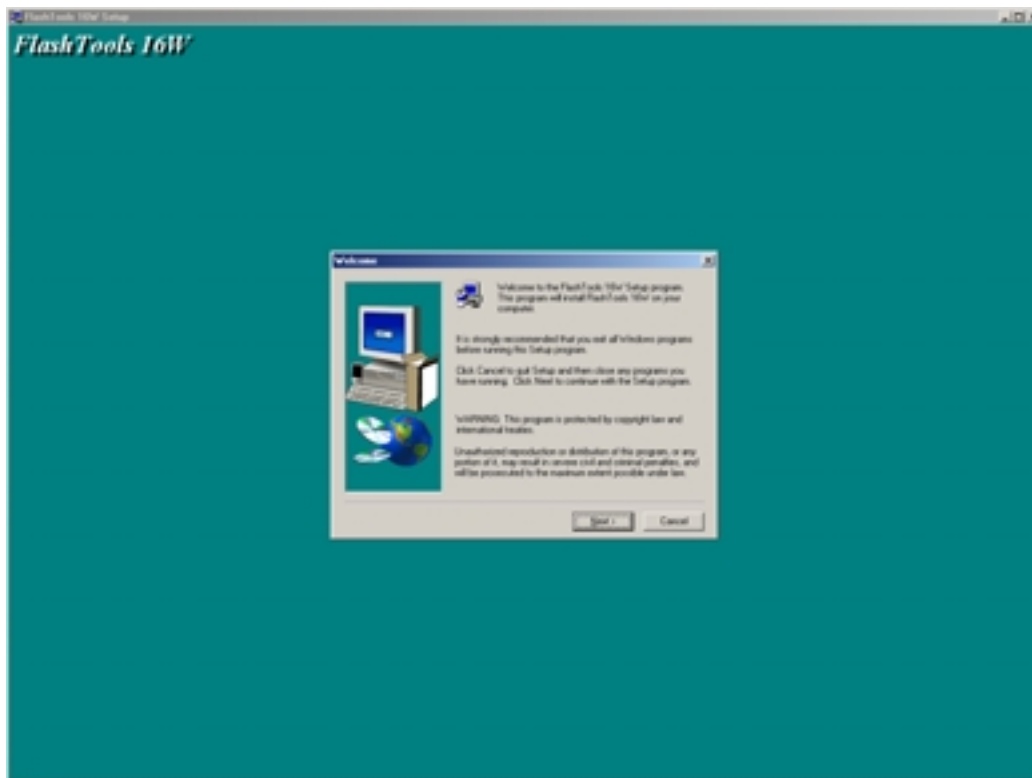
Follow the steps described below to install all components on your machine:

- Browse to the setup program for the Keil μ Vision2 software evaluation development tool chain **/Products/Tools/Keil/EK166/Setup** on your SYS TEC Products CD-ROM and run the *setup.exe*.

The applicable Keil 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 μ Vision2 from the Spectrum CD-ROM even if other versions of μ Vision2 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 Keil evaluation development tool chain. The default location is **C:\Keil**.
- Follow the Keil setup installation steps. Once installed you can start Keil μ Vision2 evaluation version by selecting *Keil uVision2* from within the *Programs* program group.
- Now install PHYTEC FlashTools 16W for Windows.
- Browse to the setup program located in the **/Products/SO-868** folder on your **SYS TEC** Products CD-ROM and run the *setup.exe*.



- Follow the FlashTools 16W setup installation steps. Once installed you can start FlashTools 16W by selecting *FlashTools 16W* from within the *Programs\SYS TEC* program group.

- Now copy all the demo programs for the DIPmodul 164 Development Kit to your hard-drive.
- Browse to the setup program located in the */Products/KMM-215/Demos* folder on your SYS TEC Products CD-ROM and run the *setup.exe*.
- Follow the setup installation steps.

2.2 Interfacing the DIPmodul 164 to a Host-PC

Connecting the DIPmodul 164, mounted on the DIPmodul Development Board, to your computer is simple:

- As shown in the figure below, if the DIPmodul 164 is not already pre-installed, mount it pins down onto the Development Board receptacle footprint (X101, referred to as DIPmodul 164 in the figure below).
- Ensure that pin 1 of module (denoted by the hash stencil mark on the PCB) matches pin 1 of the receptacle on the Development Board.
- 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 DIPmodul 164 is removed from and inserted onto the DIPmodul Development Board.

Also make sure **not** to insert the DIPmodul 164 into the second pair of contact strips for the CANopen-Chip 505!

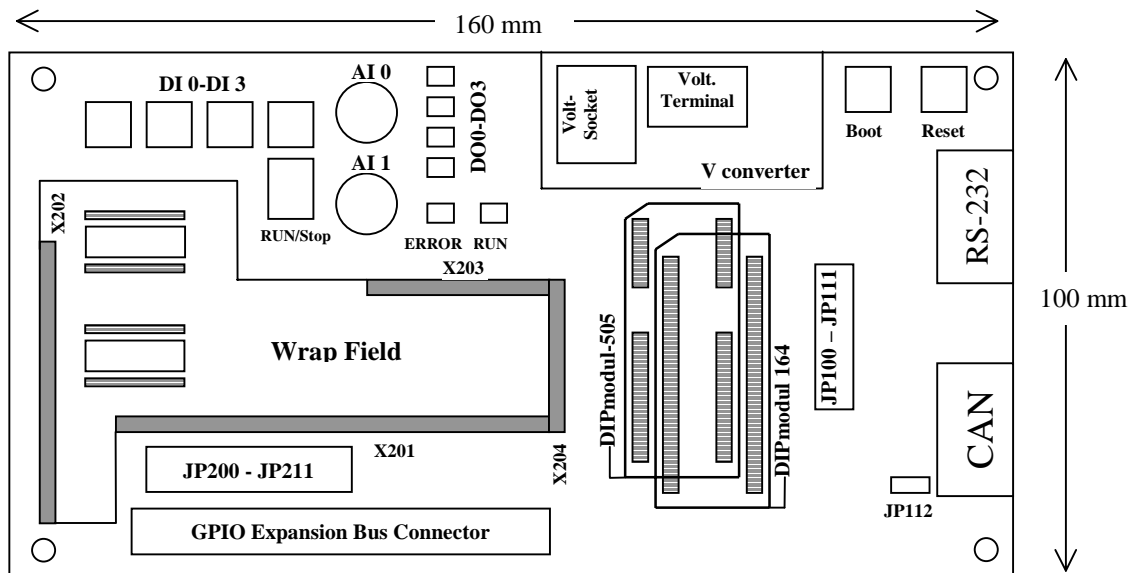


Figure 1: Development Board Overview

- Configure the jumpers on the DIPmodul Development Board as indicated below. This correctly routes the RS-232 signals to the DB-9 connector (P1) and connects the Development Board's peripheral devices to the DIPmodul 164.

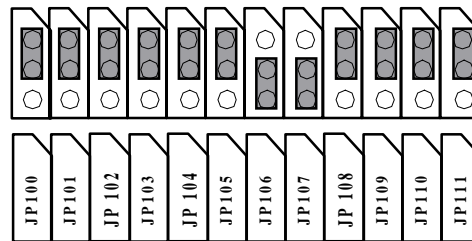


Figure 2: Suitable Development Board Jumper Settings

- Connect the RS-232 interface of your computer to the DB-9 RS-232 interface on the Development Board (P1) using the included serial cable.
- Using the included power adapter, connect the power socket on the board (X102) to a power supply (*refer to Figure 3 for the right polarity*).

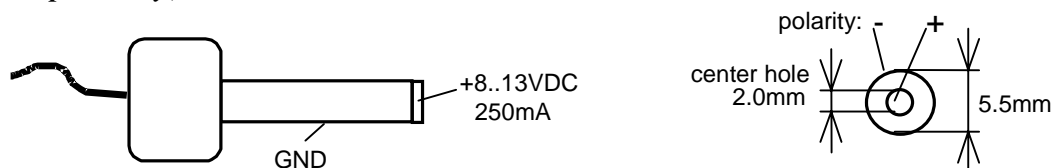


Figure 3: Power Connector

- Simultaneously press the Reset (S2) and Boot (S1) buttons on the DIPmodul Development Board, first releasing the Reset and then, two to three seconds later, release the Boot button.

This sequence of pressing and releasing the Reset and Boot buttons renders the DIPmodul 164 into Bootstrap mode. Use of FlashTools always requires the DIPmodul 164 to be in Bootstrap mode. See *section 2.4* for more details.

The DIPmodul 164 should now be properly connected via the Development Board to a host-PC and power supply. After executing a Reset and rendering the board in Bootstrap mode, you are now ready to program the DIPmodul 164. This DIPmodul 164/Development Board combination is also referred to as “target hardware”.

2.3 Starting PHYTEC FlashTools for Windows

FlashTools should have been installed during the initial setup procedure as described in section 2.1. If not, you can manually install FlashTool by executing *setup.exe* from within the **|Product|SO-868|Ft16W** folder of your SYS TEC Products CD-ROM.

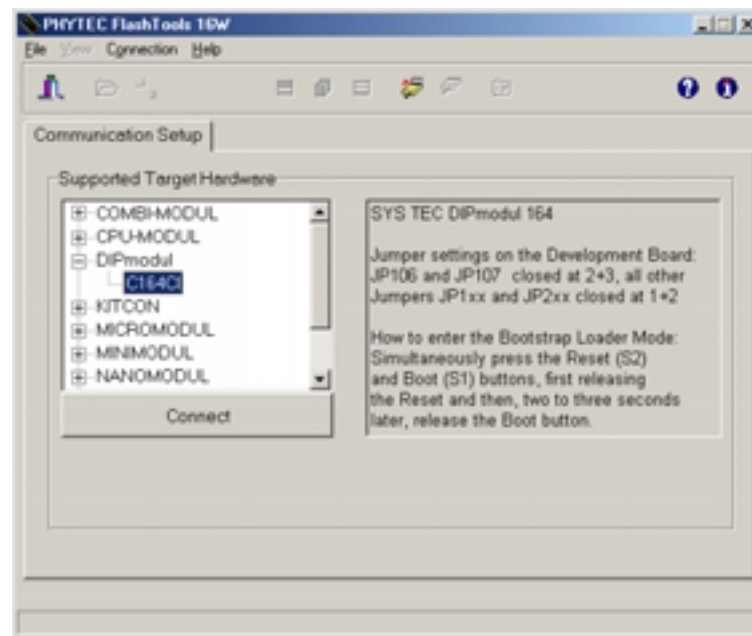
FlashTools for Windows is an utility program that allows download of user code in ***.h86** file format from a host-PC to a SYS TEC/PHYTEC Single Board Computer via an RS-232 connection. Proper connection of the DIPmodul 164 to a host-PC enables the software portion of FlashTools to recognize and communicate to the firmware portion.

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

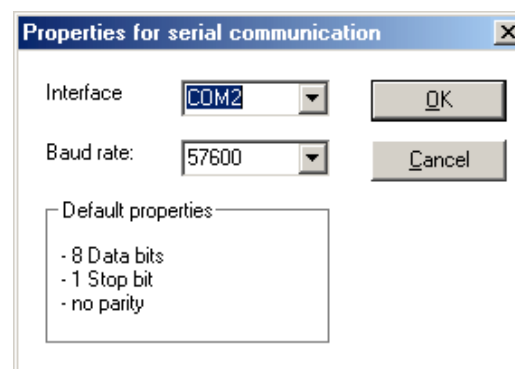
It is recommended that you drag the FlashTools icon onto the desktop of your PC. This enables easy start of FlashTools by double-clicking on the icon.

2.4 Downloading Example Code with FlashTools

- Start FlashTools for Windows by double-clicking on the FlashTools icon or by selecting *FlashTools 16W* from within the *Programs/SYS TEC* program group.
- The Communication Setup tab of the FlashTools tabsheet window will now appear. Here you can select the target hardware.
- Double-click on *DIPmodul*.



- Select the C164CI module from the list and press the *Connect* button.
- The *Properties for serial communication* window will now appear. Here you can specify connection properties to the DIPmodul 164.



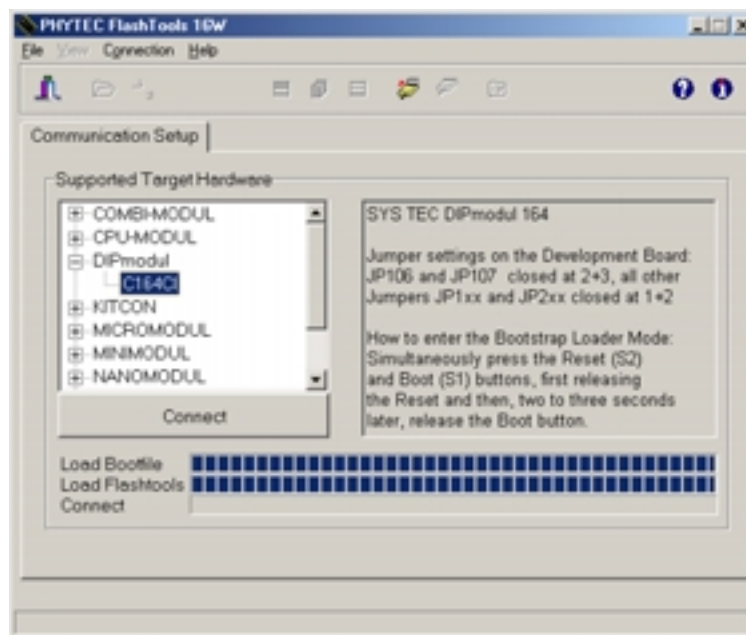
- Select the correct serial port for your host-PC and a 57,600 baudrate.

Note:

Always ensure that the DIPmodul 164 is in Bootstrap mode before pressing the *OK* button.

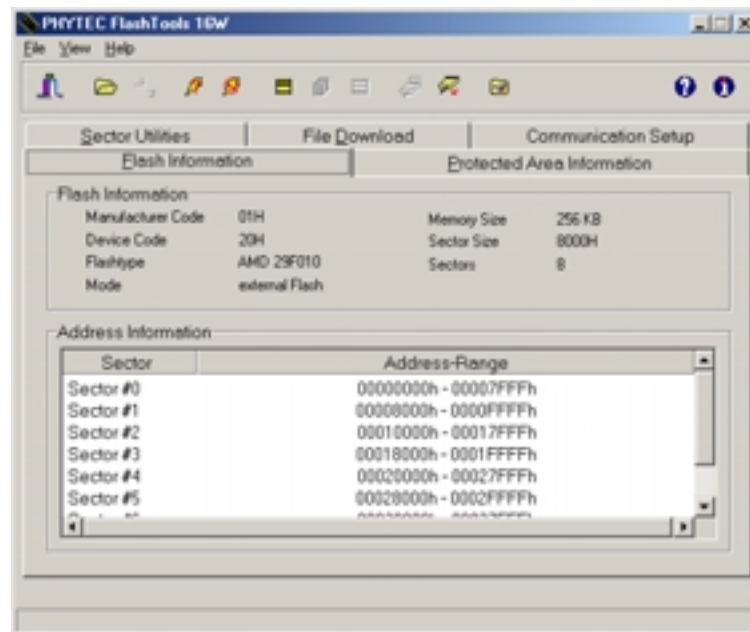
- Click on the *OK* button to establish connection to the target hardware. This also loads the hardware-related FlashTools portion to the target hardware.

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 Bootstrap mode as described in *section 2.2*.



- After the data transfer you will see FlashTools for Windows tabsheet window with the following tabs:

*Flash Information*¹ shows Flash type, sector and address ranges in Flash memory:

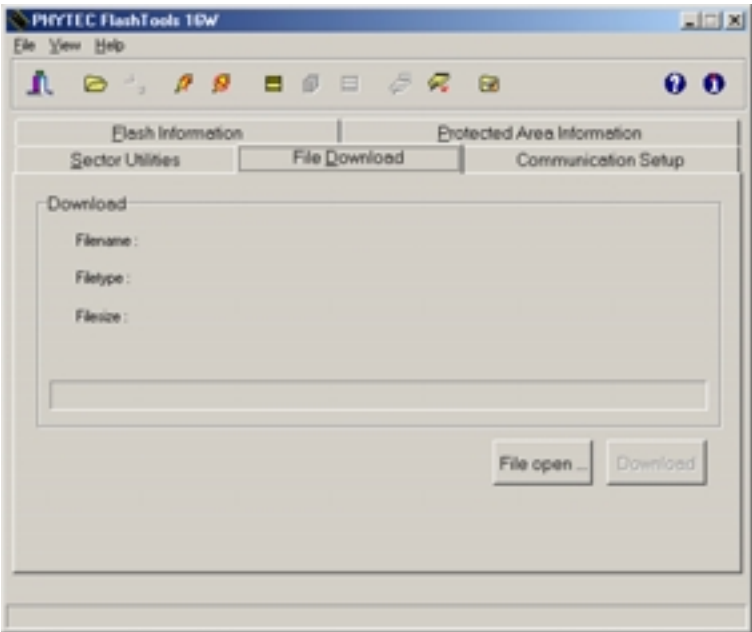


Note:

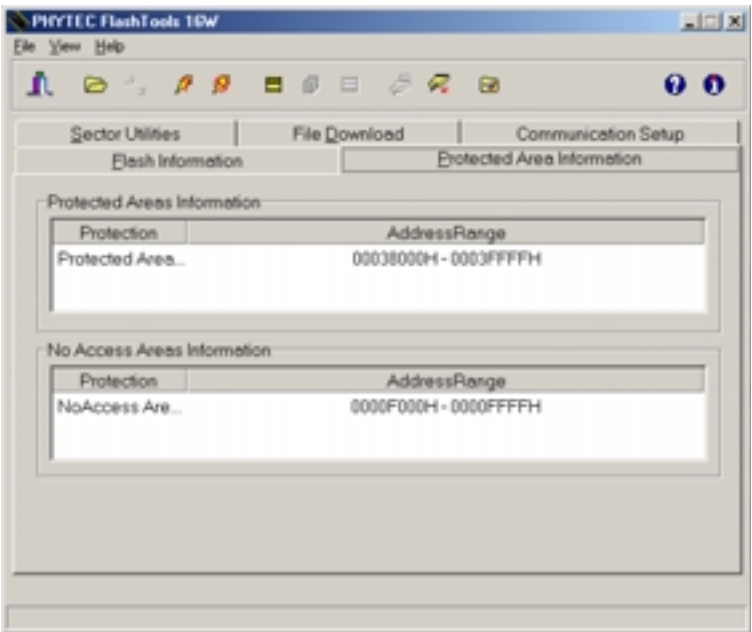
Due to an error in FlashTools the *Flash Information* window will show twice as many sectors as physically available on the DIPmodul 164. This must be considered when erasing or writing the corresponding Flash sectors. This error will be resolved in a new version of FlashTools.

¹: The appearance of the *Flash Information* tabsheet varies depending on the size and type of the Flash mounted on the DIPmodul-164.

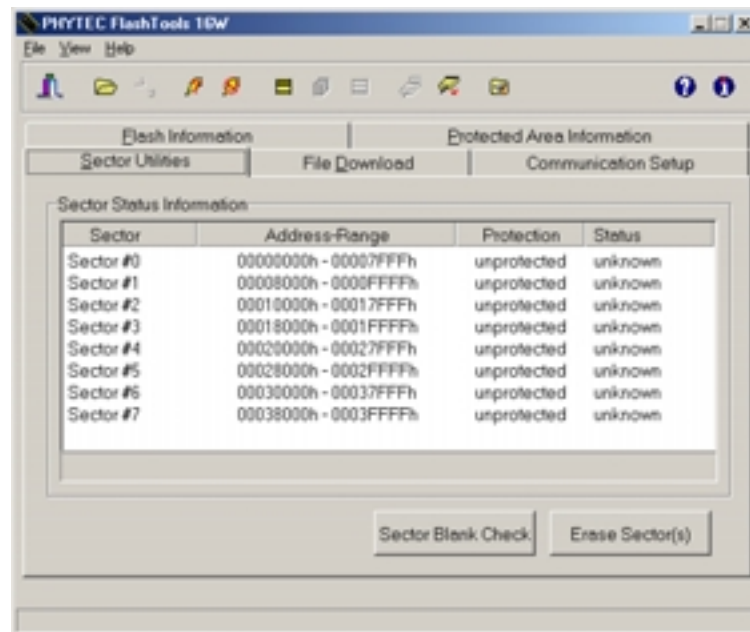
File Download downloads specified hexfiles to the target hardware:



Protected Areas Information shows protected areas of Flash memory:



*Sector Utilities*¹ enable erasure and status check of individual sectors of Flash memory specified by the user:

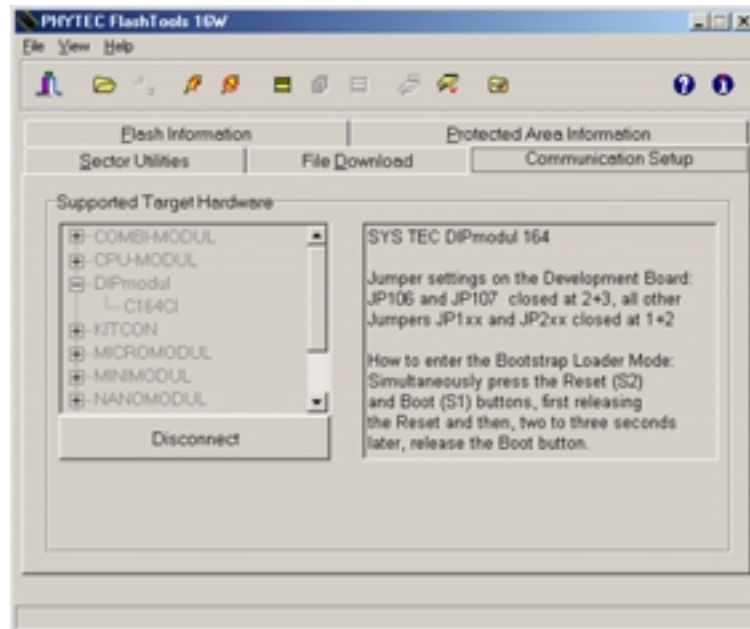


Note:

Due to an error in FlashTools the *Flash Information* window will show twice as many sectors as physically available on the DIPmodul 164. This must be considered when erasing the corresponding Flash sectors. For the example show above only Flash sectors #0 - #3 are available. Sectors #4 - #7 are a mirror of the first four sectors. This error will be resolved in a new version of FlashTools.

¹: The appearance of the *Sector Utilities* tabsheet varies depending on the size and type of the Flash mounted on the DIPmodul-164.

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



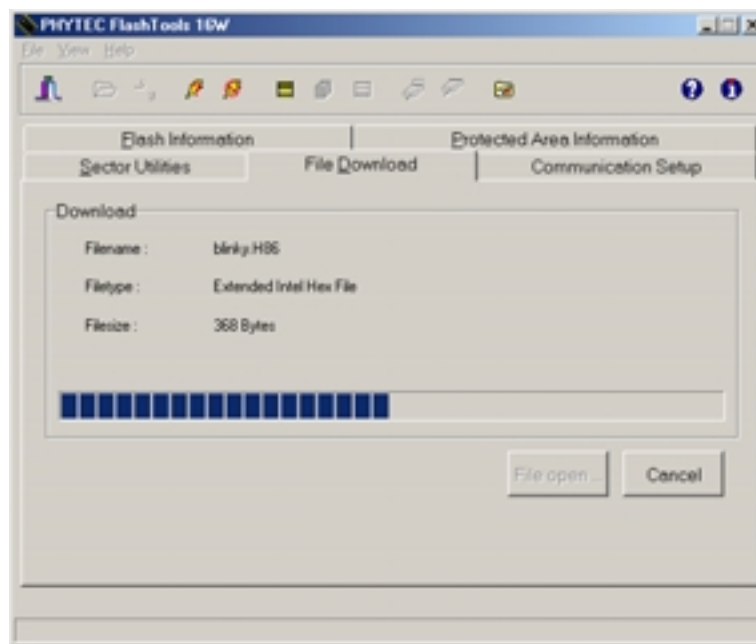
2.4.1 "Blinky"

The “Blinky” example downloads a program to the Flash that, when executed, manipulates the LED D200 (DO0) on the DIPmodul Development Board that is located between the potentiometer AI0 and the power socket (*refer to Figure 1*).

- Returning to the FlashTools tabsheet, choose the *Sector Utilities* tab, highlight *Sectors #0 - #3* within the *Sector Status Information* section, and click on the *Erase Sector(s)* button to erase these memory sectors.
- Wait until the status check in the lower left corner of the FlashTools tabsheet finishes.
- 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 DIPmodul 164 Demo folder (default location **C:\SYS TEC\Products\KMM-215\Demos\Keil\Blinky\Blinky.h86**) and click *Open*.
- Click on the *Download* button. You can watch the status of the download of the **Blinky.h86** into external Flash memory in the Download window.



If the selected Flash sector(s) 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 *Sector Utilities* tab from the FlashTools tabsheet, highlight *Sectors #0 - #3* within the *Sector Status Information* section and erase the sectors. Then repeat the download procedure.

- Returning to the *Communication Setup* tab, click on the *Disconnect* button and exit FlashTools.

- Press the Reset button (S2) on the DIPmodul 164 Development Board to reset the target hardware and to start execution of the downloaded software.
- Successful execution of the program will flash the LED D200 (DO0) with equal on and off durations.

2.4.2 "Hello"

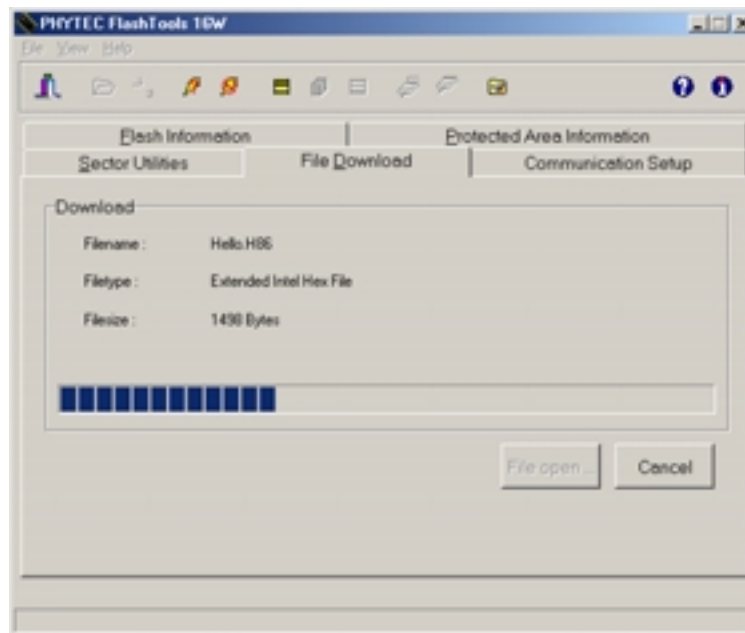
The “Hello” example downloads a program to the Flash that, when executed, performs an automatic baud rate detection and sends a character string from the target hardware back to the host-PC. The character string can be viewed with a terminal emulation program. This example program provides a review of the FlashTools 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 Bootstrap mode by simultaneously pressing the Reset (S2) and Boot (S1) buttons on the Development Board and then releasing first the Reset and, two or three seconds later, the Boot button.
- Start FlashTools.
- The *Communication Setup* tab of the FlashTools tabsheet window will now appear. Here you can select the target hardware.
- Double-click on *DIPmodul*, select the C164CI module from the list and press the *Connect* button.
- The *Properties for serial communication* window will now appear. Here you can specify connection properties to the DIPmodul 164.
- Select the correct serial port for your host-PC and a 9,600 baudrate.
- Click on the *OK* button to establish connection to the target hardware. This also loads the hardware-related FlashTools portion to the target hardware.

- Choose the *Sector Utilities* tab, highlight *Sector #0* within the *Sector Status Information* section, and click on the *Erase Sector* button to erase this memory sector.
- Wait until the status check in the lower left corner of the FlashTools tabsheet finishes.
- 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 DIPmodul 164 Demo folder (default location ***C:\SYS TEC\Products\KMM-215\Demos\Keil\Hello\Hello.h86***) and click *Open*.
- Click on the *Download* button. You can watch the status of the download of the ***Hello.h86*** into external Flash memory in the Download window.

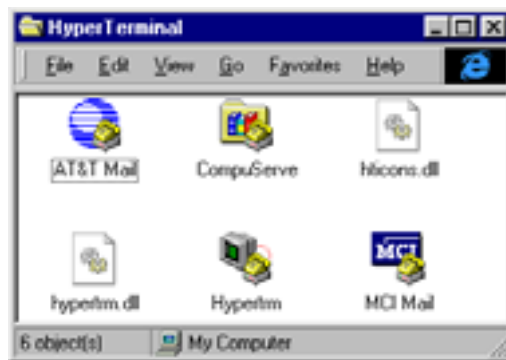


If the selected Flash sector(s) into which you wish to download code is not empty (i.e. erased), a warning dialog box will appear, indicating “Location not empty! Please erase location and try again”. In this event, select the *Sector Utilities* tab from the FlashTools tabsheet, highlight *Sectors #1 - #3* within the *Sector Status Information* section and erase the sectors. Then repeat the download procedure.

- Returning to the *Communication Setup* tab, click on the *Disconnect* button and exit FlashTools.

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 appear¹:
- 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.

¹ : The HyperTerminal window has a different appearance for different versions of Windows.

- Next click on *OK*. This creates a new HyperTerminal session named “COM Direct” and advances you to the next HyperTerminal window.



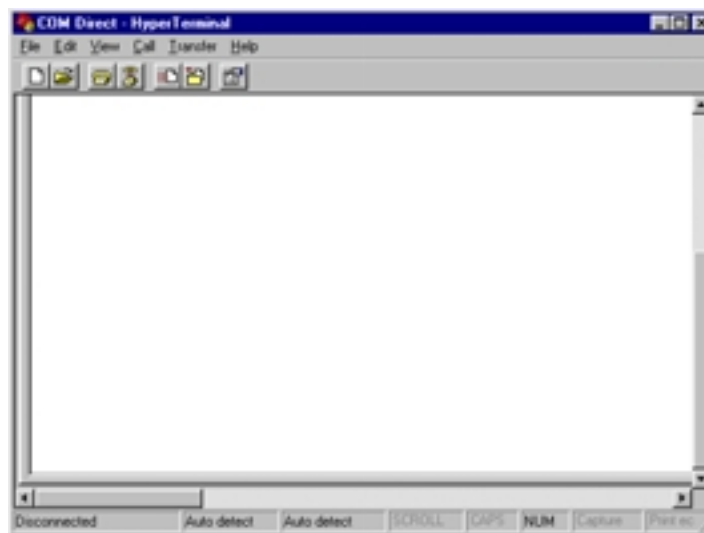
- The *COM Direct Properties* window will now appear. Specify *Direct to COM1/COM2* under the *Connect Using* pull-down menu (be sure to indicate the correct COM setting for your system).



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




- Then 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 DIPmodul Development Board (at S2) will execute the ***Hello.h86*** file loaded into the Flash.

- Now push the <Space> bar on your keyboard **twice** to start the automatic baud rate detection on the DIPmodul 164.
- 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.

3 Getting More Involved

What you will learn with this example:

- how to start the μ Vision2 tool chain
- how to configure the μ Vision2 IDE (Integrated Development Environment)
- how to modify the source code from our examples, create a new project and build and download an output *.h86 file to the target hardware

3.1 Starting the Keil μ Vision2 Tool Chain

The Keil μ Vision2 evaluation software development tool chain should have been installed during the install procedure, as described in *section 2.1*.

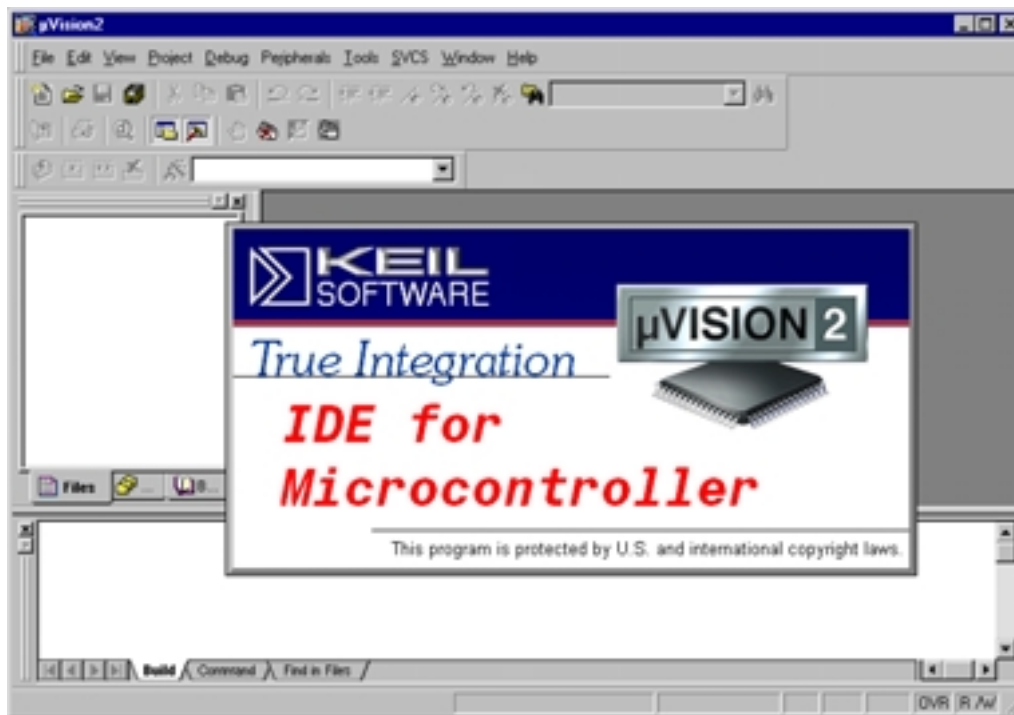
You can also manually install μ Vision2 by executing *setup.exe* from within the *\Products\Tools\Keil\EK166\Setup* directory of your SYS TEC Products CD.

Note:

It is necessary to use the Keil 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 *Keil μ Vision2* from within the *Programs* group.

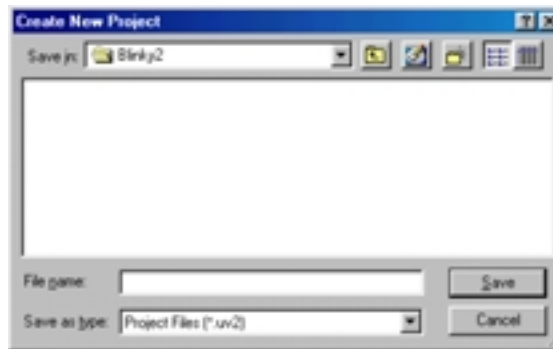
After you start μ Vision2, the window shown below appears. From this window you can create projects, edit files, configure tools, assemble, link and start the debugger. Other 3rd party tools such as emulators can also be started from here.



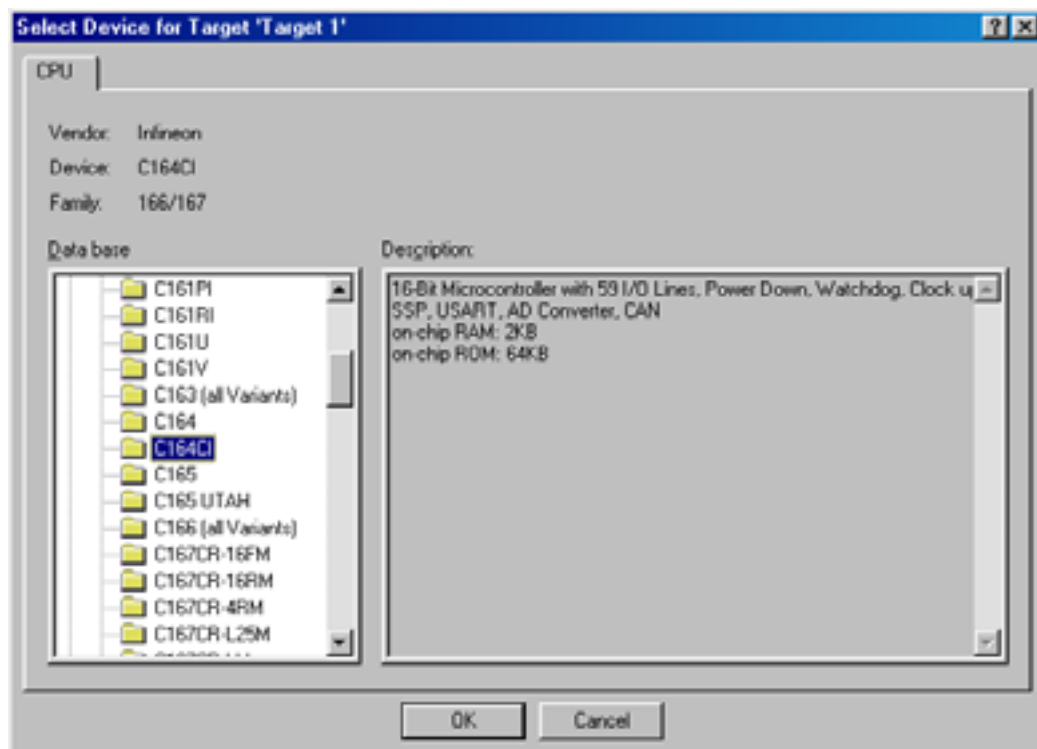
3.2 Creating a New Project and Adding an Existing Source File

µVision2 automatically loads the most recently opened project. If you find an existing project when starting µVision2, close it by selecting the *Project* menu and *Close* the project.

- To create a new project file select from the µVision2 menu **Project/New Project....** This opens a standard Windows dialog box that asks you for the new project file name.
- Change to the project directory created by the installation procedure (default location **C:\SYS TEC\Products\KMM-215\Demos\Keil\Blinky2**).

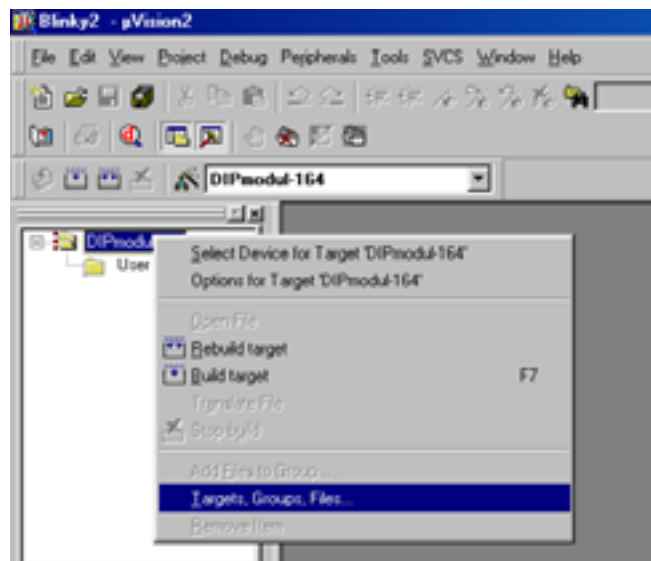


- In the text field '*File name*', enter the file name of the project you are creating. For this example, enter the name ***Blinky2*** and click on *Save*.
- The ***Select Device for Target 'Target 1'*** window will appear. Double-click on *Infineon* in the CPU vendor data base list. The DIPmodul 164 is equipped with an *Infineon C164CI*. Choose this controller type from the list as shown below. This selection sets necessary tool options for the *C164CI* device, as well as pre-configures additional settings for the device.



- Click on *OK*.

- Now click on *Target1* within the **Project Window - Files** tab. *Target1* is now highlighted. Click on *Target1* again to enable the edit mode. Change the default name of the target to *DIPmodul 164*.
- Select the file group *Source Group 1* in the **Project Window – Files** tab and click on it to change the name into *User*.
- Right-click in the **Project Window – Files** section to open a new window. Choose the option *Targets, Groups, Files....*



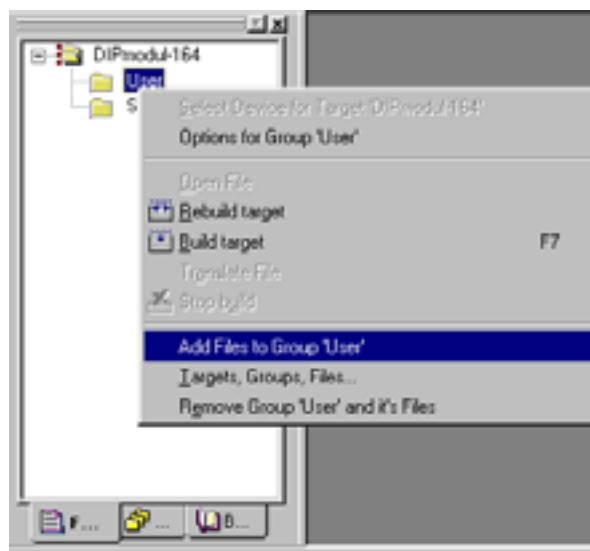
- Select the tab **Groups / Add Files** and type the new group name *System Files* in the **Group to Add:** section.



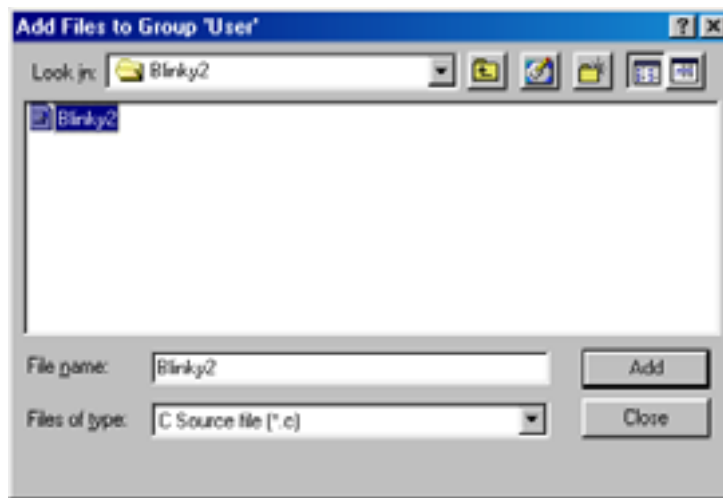
- Click on *Add* and then on *OK*.
- Your project file structure should now look like this:



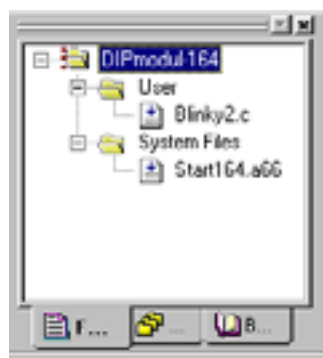
- In order to add ***Blinky2.c*** to our project right-click on the *User* group to open a menu. Select the option ***Add Files to Group 'User'*** to open the standard files dialog.



- Select the file **Blinky2.c**.



- Click on the *Add* button to add the **Blinky2.c** file to your current project window.
- Close the window.
- Now right-click on group *System Files* and add the file **Start164.a66**. Change to the project directory **Startup** created by the installation procedure (default location **C:\SYS TEC\Products\KMM-215\Demos\Keil\Startup**). You also have to change the file type to “**Asm Source file (*.a, *.src)**” in the *File of types* pull-down menu to see this file.
- Your project window should now look like this:

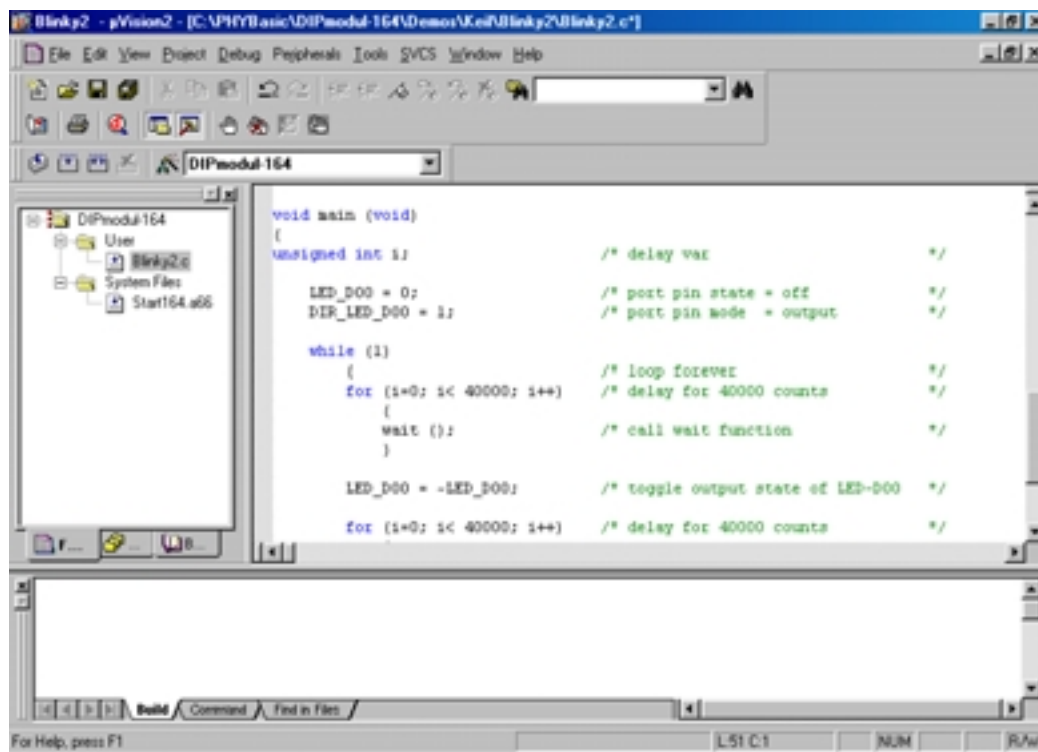


At this point you have created a project called **Blinky2.uv2** and added an existing C source file called **Blinky2.c** and an existing assembler file called **Start164.a66**.

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

3.3 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 (40,000) counts to the indicated values:

```
while (1) {                                /* loop forever          */


    for (i=0; i< 40000; i++) /* delay for 40000 counts          */
    {
        wait ();              /* call wait function        */
    }

    LED_DO0 = ~LED_DO0;        /* toggle output state of LED DO0 */

    for (i=0; i< 10000; i++) /* delay for 10000 counts          */
    {
        wait();              /* call wait function          */
    }
}
```

This will change the LED on/off ratio.

3.4 Saving the Modifications

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

3.5 Setting Tool Chain Options

Keil μ Vision2 includes a Make utility that can control compiling and linking source files in several programming languages. Before using the Make utility, macroassembler, C compiler or linker you must configure the corresponding options. Most of the options are set by specifying the target device for the project. Only the external memory and output options must be set.

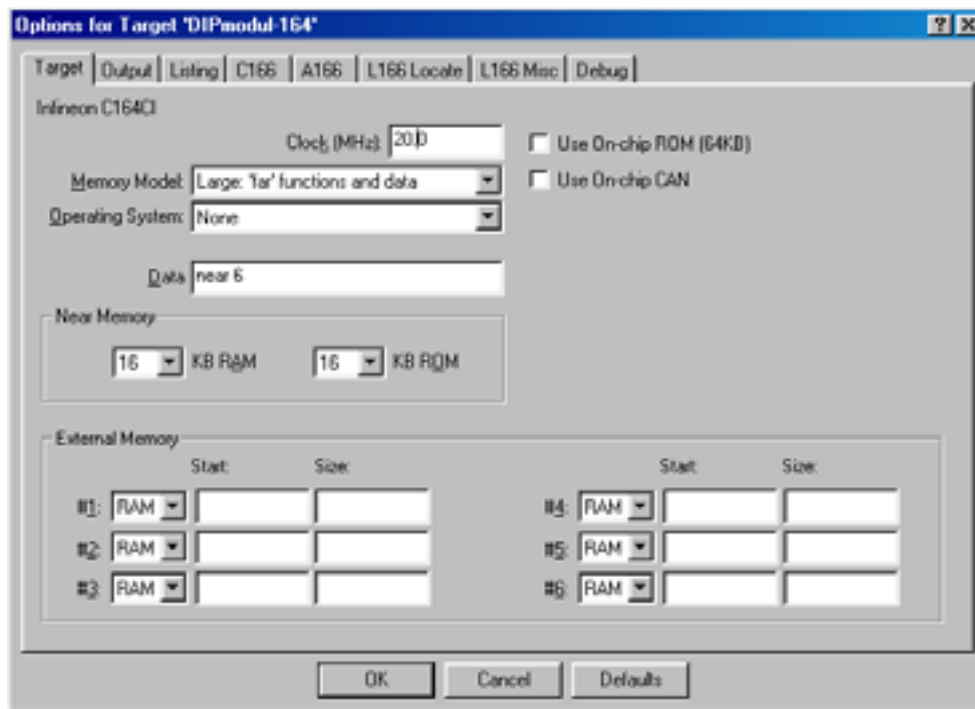
Enter the changes as indicated below and leave all other options set to their default values. μ Vision2 allows you to set various options with mouse clicks and these are all saved in your project file.



- Select the target *DIPmodul 164* within the project window.

To configure the Target:

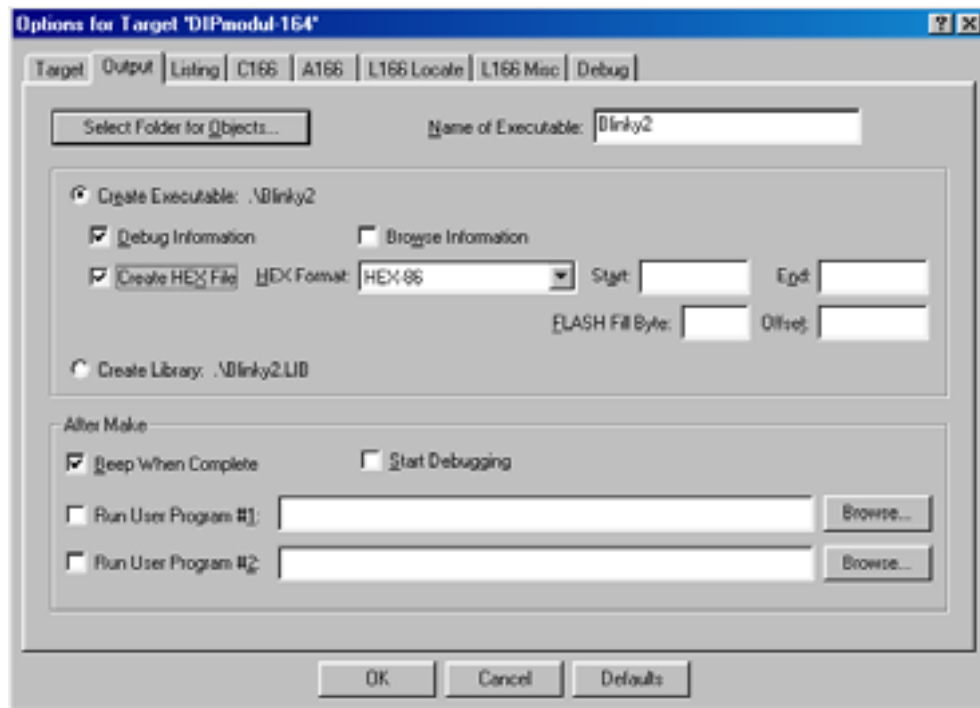
- Open the **Project/Options for Target 'DIPmodul 164'** menu and change the default settings to the correct values for the DIPmodul 164 as shown in the figure below. This includes settings for the clock frequency of your DIPmodul and the memory model.



- The DIPmodul 164 is populated with a 32 kByte linear accessible SRAM device. This allows selection of the **Large: variables in XDATA** memory model.

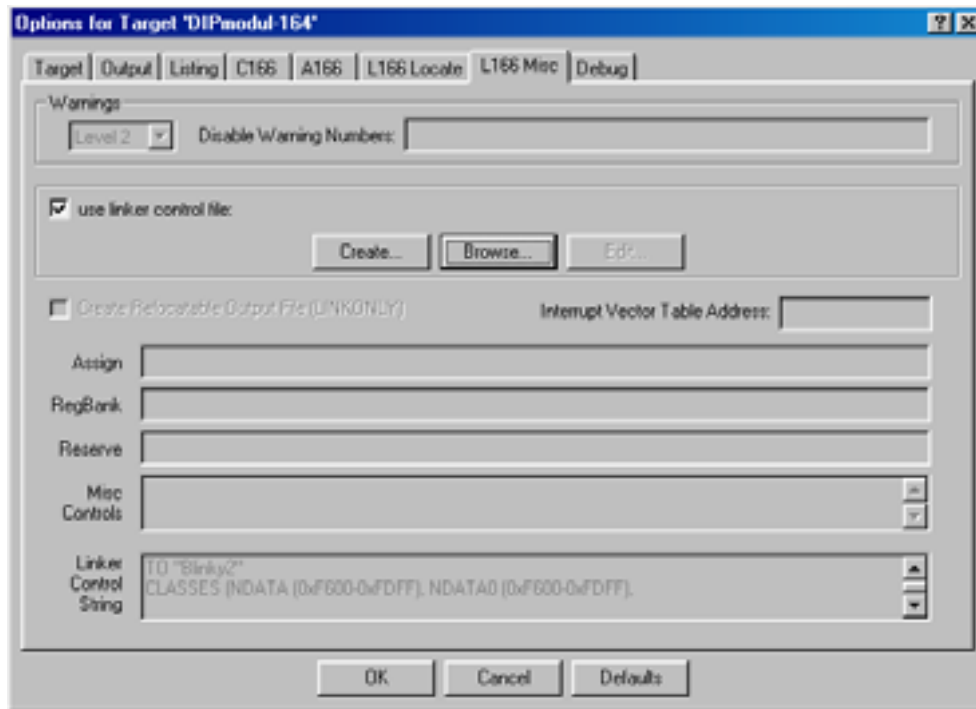
To configure the Output options:

- Select the **Output** tab and activate the *Create HEX File* checkbox. With this option a *.**h86** file will be created for download.

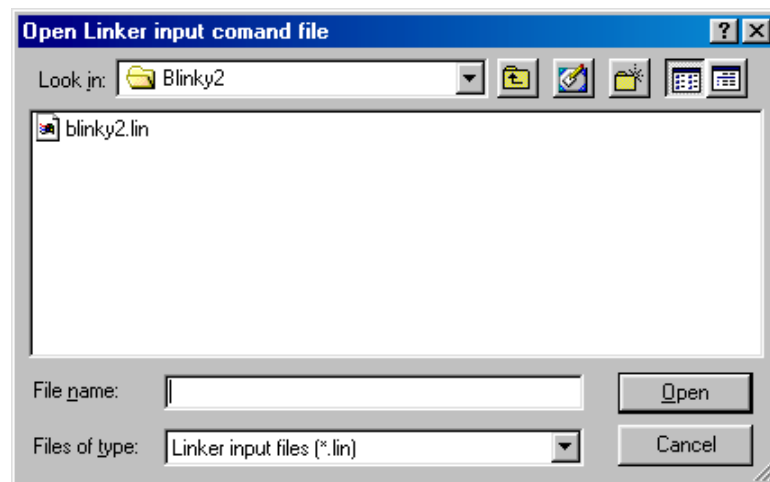


To configure the Linker options:

- Select the **L166 Misc** tab and activate the *use linker control file* checkbox.



- Click on the *Browse...* button. The following window will appear:



- Select the **Blinky2.lin** file and click *Open*.
- Click on *OK* in the **Options for Target 'DIPmodul 164'** menu.

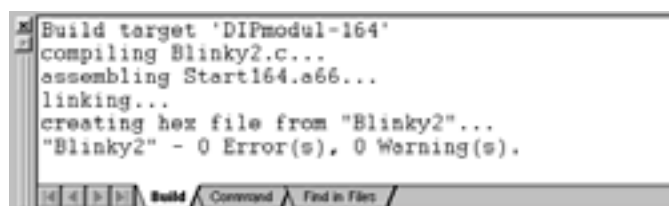
3.6 Building the Project

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

- Click on the *Build Target* icon  from the µVision2 toolbar or press <F7>.

If the program specified (*Blinky2.c*) contains any errors, they will be shown in an error dialog box on the screen.

If there are no errors, the code is compiled and linked and the executable code is ready to be downloaded to the module. This is shown in the *Output Window*, which indicates "*Blinky2*" - 0 Errors, 0 Warnings. The created hexfile will have the name of the project with *.h86* as the filename extension (in this case *Blinky2.h86*).

**Note:**

A machine-readable, executable hexfile has been created. Other files (e.g. 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, save the file and (re-)build the project.

3.7 Downloading the Output File

- Reset the target hardware and force it into Bootstrap mode by simultaneously pressing the Reset (S2) and Boot (S1) buttons on the DIPmodul Development Board and then releasing first the Reset and, two or three seconds later, the Boot button.
- Start FlashTools.
- The *Communication Setup* tab of the FlashTools tabsheet window will now appear. Here you can select the target hardware.
- Double-click on *DIPmodul*, select the C164CI module from the list and press the *Connect* button.
- The *Properties for serial communication* window will now appear. Here you can specify connection properties to the DIPmodul 164.
- Select the correct serial port for your host-PC and a 9,600 baudrate.
- Click on the *OK* button to establish connection to the target hardware. This also loads the hardware-related FlashTools portion to the target hardware.
- Choose the *Sector Utilities* tab, highlight *Sector #0* within the *Sector Status Information* section, and click on the *Erase Sector* button to erase this memory sector.
- Wait until the status check in the lower left corner of the FlashTools tabsheet finishes.
- Next choose the *File Download* tab and click on the *File Open* button.
- Browse to the correct drive and path for the DIPmodul 164 Demo folder (default location
C:\SYS TEC\Product\KMM-215\Demos\Keil\Blinky2\Blinky2.h86) and click *Open*.
- Click on the *Download* button. You can watch the status of the download of the ***Blinky.h86*** into the external Flash memory in the Download window.
- Returning to the *Communication Setup* tab, click on the *Disconnect* button and exit FlashTools.
- 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.

3.8 “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*.

3.8.1 Creating a New Project

- Start the Keil μ Vision2 environment and close all projects that might be open.
- Open the **Project** menu and create a new project called **Hello2.uv2** within the existing project folder
C:\SYS TEC\Products\KMM-215\Demos\Keil\Hello2 (default location) on your hard-drive. Select the Infineon C164CI in the CPU vendor data base list.
- Add **Hello2.c** and **Serinit.lib** from within the project folder and **Start164.a66** from within the **Startup** folder to the project **Hello2.uv2**.
- Your project window should now look like this:



- Save the project.

At this point you have created a project called ***Hello2.uv2*** consisting of a C source file called ***Hello2.c***, a library called ***Serinit.lib*** and an assembler file called ***Start164.a66***.

3.8.2 Modifying the Example Source

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

```
printf ("\x1AHello World\n")
```

to

```
printf ("\x1ASYS TEC... Stick It In!\n")
```

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

3.8.3 Setting Tool Chain Options

- Open the ***Project/Options for Target...*** menu and change the default settings to the correct values as shown in *section 3.5*. This includes settings for the clock frequency of your DIPmodul and the memory model (make sure “*Large: variables in XDATA*” is configured).
- Modify the default options for the output file by selecting the ***Create HEX File*** checkbox in the ***Project/Options for Target..../Output*** tab. This will automatically create a ****.h86*** file for download to the DIPmodul 164 after compiling.
- Select the ***L166 Misc*** tab, activate the *use linker control file* checkbox and include the ***Hello2.lin*** file.
- Click on ***OK*** in the ***Options for Target ‘DIPmodul 164’*** menu to save all the settings.

3.8.4 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.

3.8.5 Downloading the Output File

- Reset the target hardware and force it into Bootstrap mode by simultaneously pressing the Reset (S2) and Boot (S1) buttons on the DIPmodul Development Board and then releasing first the Reset and, two or three seconds later, the Boot button.
- Start FlashTools.
- The *Communication Setup* tab of the FlashTools tabsheet window will now appear. Here you can select the target hardware.
- Double-click on *DIPmodul*, select the C164CI module from the list and press the *Connect* button.
- The *Properties for serial communication* window will now appear. Here you can specify connection properties to the DIPmodul 164.
- Select the correct serial port for your host-PC and a 9,600 baudrate.
- Click on the *OK* button to establish connection to the target hardware. This also loads the hardware-related FlashTools portion to the target hardware.
- Choose the *Sector Utilities* tab, highlight *Sector #0* within the *Sector Status Information* section, and click on the *Erase Sector* button to erase this memory sector.
- Wait until the status check in the lower left corner of the FlashTools tabsheet finishes.
- Next choose the *File Download* tab and click on the *File Open* button.

- Browse to the correct drive and path for the DIPmodul 164 Demo folder (default location **C:\SYS TEC\Products\KMM-215\Demos\Keil\Hello2\Hello2.h86**) and click *Open*.
- Click on the *Download* button. You can watch the status of the download of the **Hello2.h86** into the external Flash memory in the Download window.
- Returning to the *Communication Setup* tab, click on the *Disconnect* button and exit FlashTools.

3.8.6 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 DIPmodul Development Board (at S2) will execute the **Hello2.hex** file loaded into the Flash.
- Now push the <Space> bar on your keyboard twice to start the automatic baud rate detection on the DIPmodul 164.
- Successful execution will send the modified character string **"SYS TEC... 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 Advanced User Information

This section provides advanced information for successful operation of the DIPmodul 164 with μ Vision2.

4.1 Start164.A66

The code within the assembly file *start164.a66* is responsible for the initial controller configuration and the startup initialization of your C project. This includes adjusting the properties of the external bus signals and chip select signals, setting of the system stack, initialization of variables and clearing of memory areas.

It is very important that this code will execute prior to the execution of user code. To ensure this, it is recommended that the startup code occupies the Reset Vector of the application, which is the location where the microcontroller starts execution after reset (0x0000). After performing the initialization steps your individual *main()* function is called by the startup code.

Since some of the settings are hardware-dependent, we recommend use of the prepared *start164.a66* from within the default location **C:\SYS TEC\Products\KMM-215\Demos\Keil\Startup** on your hard-drive. The properties of the external bus interface are already configured for the DIPmodul 164. You may want to change the values for the chip select units.

To accommodate the startup code to the needs of your application copy it from the directory described above to your project directory. You can then edit, modify and compile it using the Keil macroassembler.

4.2 Function of the XPEN Bit in Start164.a66

The XPEN bit in the startup code enables or disables the access to the CAN controller of the C164CI. The on-chip CAN controller address area starts at 0x0EF00 and occupies 256 Bytes. To enable this area, the XPEN bits must be set to "1". If you set this bit to "0" you have access to external memory.

4.3 Debugging using the Bootstrap Monitor

Whenever you decide to use the μ Vision2 target debugger or target monitor to debug your application, some special precautions must be taken into consideration to ensure proper code execution of your application.

Note:

The current version of Keil μ Vision2 and C166 tools do not include the necessary files for the correct monitor configuration on the DIPmodul 164. In order to allow hardware debugging using the Bootstrap loader you need to manually copy some files into the C:\Keil\C166\Monitor folder. Browse to your **C:\SYS TEC\Products\KMM-215\Tools\Keil\Monitor** (default location) folder. Copy the complete **SYS TEC DM164** folder to your Keil C166 Monitor folder. Also copy the three other files **SYS TEC DM164.bot**, **SYS TEC DM164.mon** and **SYS TEC DM164.txt** to the same Keil C166 Monitor destination folder.

Your application and the Keil monitor kernel contained in the files **SYS TEC DM164.BOT** und **SYS TEC DM164.MON** must share some memory locations within the target system. If you do not consider the physical memory model already claimed by the kernel and the memory requirements of the kernel, you may get conflicts in memory use. This typically leads to variables containing not their assigned value, functions returning bad results and modified code.

We recommend using the *start164.a66* file within the default location *C:\SYS TEC\Products\KMM-215\Demos\Keil\Startup* if you want to debug your application using the monitor kernel. This file will adjust the external bus properties and the chip select unit in exactly the same manner as the monitor kernel.

To obtain information about the memory requirements of the monitor, the corresponding map file *monitor.m66* is made available together with the *monitor* executable file. This file contains a detailed memory map of the monitor and is also located in the default destination mentioned above.

You must link your application properly to prevent any overlapping memory ranges. Since the monitor also uses some special interrupts for communication with the host-PC at runtime, you should add a *Reserve:* statement for the memory areas 0x008-0x011, 0x0AC-0x0AF to the *L166Misc* tab of your *Options for Target* window to reserve at least these memory ranges.

You should always ensure that segments of your application will not reach the segments of the monitor. The monitor's segments will usually be linked to the top of the available memory, leaving you as much memory space as possible for the application code.

The monitor is linked under the assumption that the maximum memory configuration for Flash and SRAM is used. Remember that you will have additional mirrors of physical devices actually mounted on the DIPmodul 164 if their capacity is less than the maximum value of 512 kByte.

For example:

You have a DIPmodul 164 with 32 kByte of RAM (standard configuration). You will find 16 additional mirrors of this RAM memory area within the reserved 512 kByte range. In this case all associated address ranges such as:

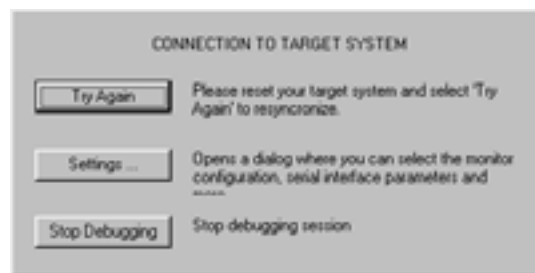
0x08000-0x0FFFF, 0x10000-0x17FFF, 0x18000-0x1FFFF,
0x20000-0x27FFF, 0x28000-0x2FFFF, 0x30000-0x37FFF,
0x38000-0x3FFFF, 0x40000-0x47FFF, 0x48000-0x4FFFF,
0x50000-0x57FFF, 0x58000-0x5FFFF, 0x60000-0x67FFF,
0x68000-0x6FFFF, 0x70000-0x77FFF and 0x78000-0x7FFFF

will actually contain the same data as the physical device at address range 0x00000-0x07FFF. This means that the same physical memory location can be addressed using 16 different internal addresses. This must be taken into consideration when verifying your memory mappings.

5 Appendices

5.1 μ Vision2 Debugger in Monitor Mode

Whenever the Keil μ Vision2 communication to the target system is not successful, it will prompt an error message as shown in the dialog box below. If this happens, check if the correct serial port is selected within the Debugger *Settings...* or try other baud rates. Render the target system into Bootstrap mode and then click on *Try Again*



The serial FIFO buffer in Windows95 can cause transmission problems. μ Vision2 debugger may have problems completing the communication initialization process. The FIFO can be disabled under *Control/System/Device/Manager/Port Settings/Advanced*. Make sure *Use FIFO buffers* in this menu is not activated.

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