

phyCORE[®]-LPC3180

QuickStart Instructions

Using IAR's JLINK and the IAR EWARM
Software Development Tool Chain

Note: The PHYTEC Spectrum CD includes the electronic version of the English
phyCORE-LPC3180 Hardware Manual

Edition: November 2006

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1 Introduction to the Rapid Development Kit

The phyCORE-LPC3180 SBC module is designed to be plugged into the appropriate PHYTEC Carrier Board. The phyCORE-LPC3180 Carrier Board contains the I/O connectors as well as any other interface circuitry not provided on the phyCORE module itself. The phyCORE module, combined with the PHYTEC Carrier Board, provides a platform to jump start embedded designs and propel concept to prototype and finished product.

Each PHYTEC Rapid Development Kit contains an SBC module mounted on an applicable Carrier Board, cables, power supply, printed schematics, applicable evaluation software development tool CDs, and the PHYTEC Spectrum CD. The PHYTEC Spectrum CD-ROM provides this QuickStart guide, complete electronic documentation and demo programs.

1.1 Rapid Development Kit Documentation

This "Rapid Development Kit" (RDK) includes the following documentation on the enclosed "PHYTEC Spectrum for ARM7/9 CD-ROM":

- the PHYTEC [phyCORE-LPC3180 Hardware Manual](#)
- LPC3180 controller User's Manuals and Data Sheets
- this QuickStart Instruction

1.2 Overview of this QuickStart Instruction

This QuickStart Instruction gives a general "Rapid Development Kit" description, as well as software installation hints and example programs enabling quick out-of-the box start-up of the phyCORE-LPC3180 in conjunction with the IAR JLINK and EWARM software tools. The "*Getting Started*" section first describes how to interface the phyCORE-LPC3180 target hardware to a host PC using the IAR JLINK. The **GettingStarted** example project demonstrates how to download user code to various memory resources available on the phyCORE-LPC3180 using the JLINK and EWARM software tools. Steps for downloading code to the on-board NAND Flash are also provided along with a Flash erasure demo.

2 System Description

2.1 Hardware Description

The following PHYTEC hardware components are included in the phyCORE-LPC3180 Rapid Development Kit (KPCM-031-IAR) and are necessary for completing the instructions in this application note:

- the PHYTEC phyCORE-LPC3180 (PCM-031)
- the phyCORE-LPC3180 Carrier Board (PCM-976)
- AC adapter supplying 5 VDC /min. 500 mA, center positive
- RS-232 DB9 serial cable (not needed for QuickStart)
- USB A to B cable
- the IAR JLINK JTAG-USB adapter, **only** included in the IAR Rapid Development Kit version¹
- the PHYTEC Spectrum CD for ARM
- the IAR Embedded Workbench Evaluation Tools CD

2.2 Host System Requirements

- Operating System: Windows 98, Windows NT Version 4, Windows 2000, Windows XP
- CPU architecture: Any x86 32-bit or 64-bit (x64: AMD64 or Intel EM64T) processor
- 50MB Free Hard Disk Space
- 128MB of RAM

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



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



<http://www.iar.com>

¹: The IAR JLINK is included in the Rapid Development Kit version with the part number KPCM-031-IAR.

2.3 The PHYTEC phyCORE®-LPC3180

The phyCORE-LPC3180 supports the industry's first 90nm ARM-9 based microcontroller. The new 32-bit MCU high-performance, low power LCP3180 ARM926EJ-S device from NXP Semiconductors (founded by Philips) is the only ARM9 microcontroller that provides a vector floating-point co-processor and integrated USB OTG, as well as the ability to operate in ultra-low-power mode down to 0.9V. The on-board MMU supports many embedded operating systems. Other chip-level features include 7 UARTs, SPI, I²C, a real-time clock with a separate power domain, and NAND Flash and DDR memory controllers.

Please refer to the [phyCORE-LPC3180 Hardware Manual](#) for specific information on-board-level features, jumper configuration, memory mapping, pin layout, and carrier board features.

2.4 IAR EWARM Software Development Tool Chain

IAR Systems provides a complete set of development tools for ARM, ranging from evaluation environments to highly optimizing C/C++ compilers and executable UML tools.

IAR Embedded Workbench is a suite of tools for building and debugging embedded applications. It supports ARM7, ARM9, ARM9E, ARM10, ARM11 and XScale devices. For more information on the IAR EWARM tools visit their website at:

<http://www.iar.com/>

3 Getting Started

What you will learn with this Getting Started example:

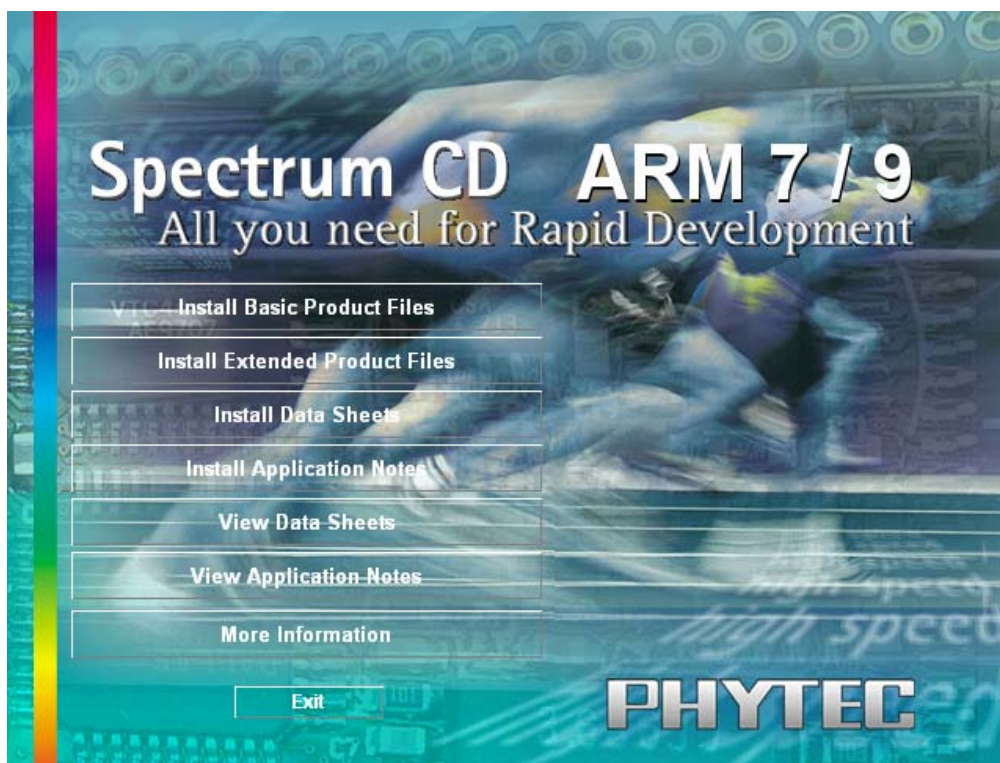
- installing Rapid Development Kit software
- interfacing the phyCORE-LPC3180, mounted on the Carrier Board, to a host-PC using the IAR JLINK
- downloading example user code from a host-PC to the internal RAM, on-board external RAM and the on-board external NAND Flash memory using EWARM tools

3.1 Installing Rapid Development Kit Software

3.1.1 Installing Demos and Documentation from Spectrum CD

When you 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 demos and documentation required for the Rapid Development Kit. Otherwise the setup program **start.exe** can be manually executed from the root directory of the PHYTEC Spectrum CD.

The following window appears:



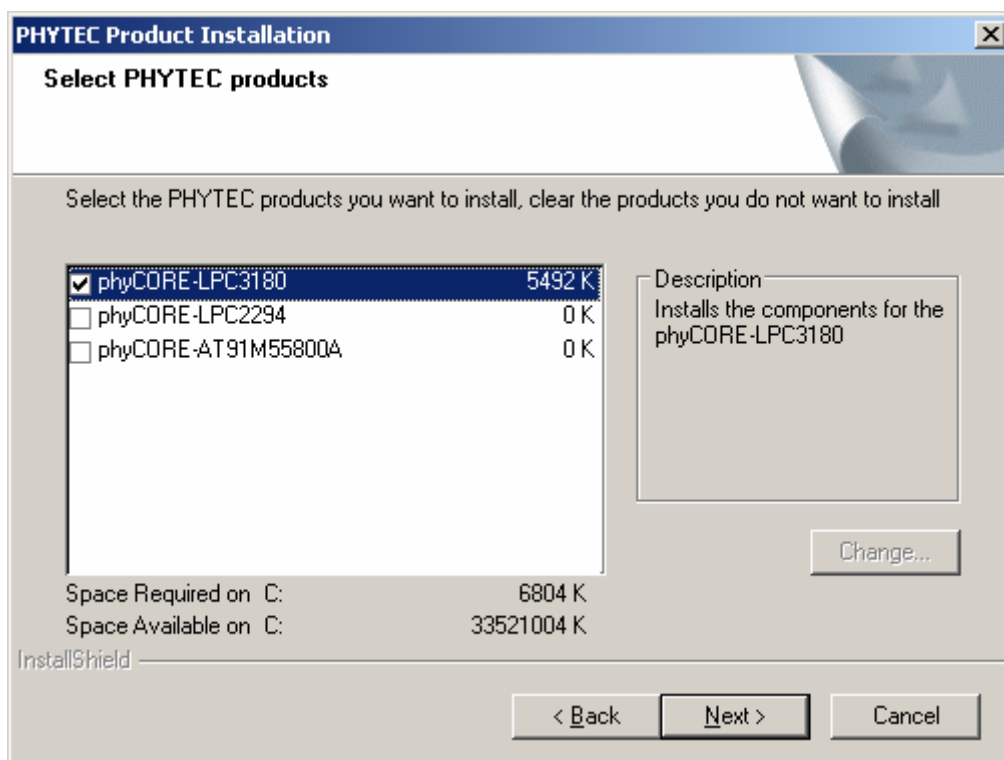
- Choose *Install Basic Product Files* Button.

- 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.

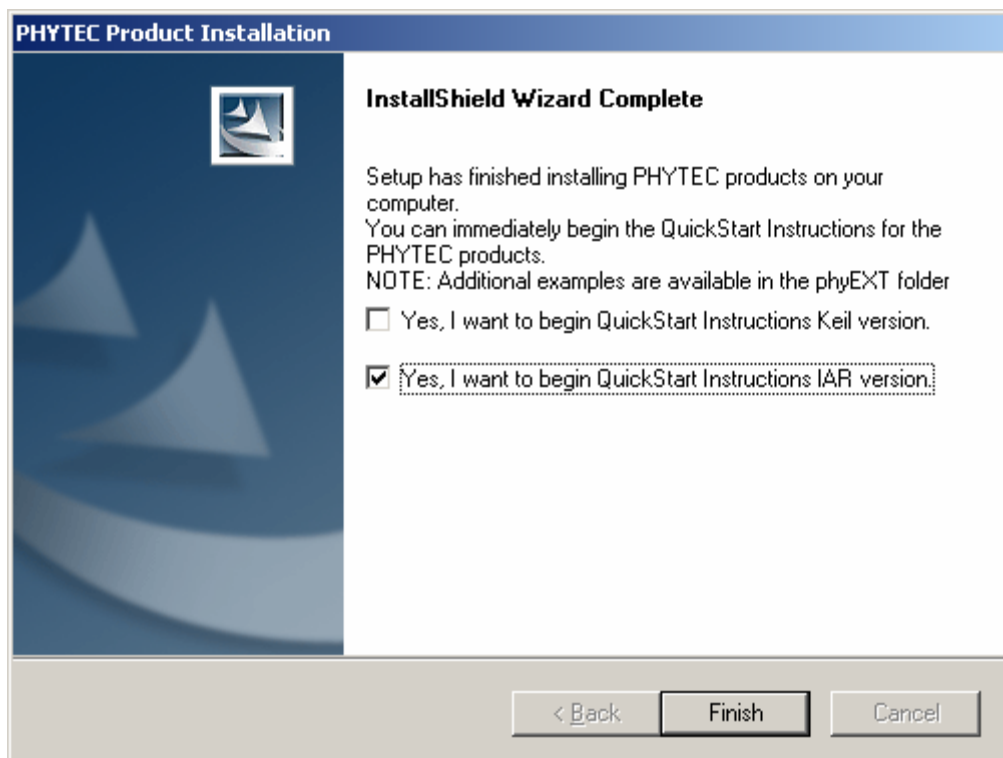


- In the next dialog you must choose whether to copy the selected documentation as *.pdf files to your hard drive or to install a link to the file on the Spectrum CD.

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.

- Adobe's Acrobat Reader V7.0 is offered for installation during the next setup step. PHYTEC PDF manuals require use of Acrobat Reader V7.0 or higher.

- At the end of the CD installation you can open the QuickStart instructions manual for the IAR EWARM tools. Check the applicable box and click on *Finish*.



3.1.2 Installing IAR Embedded Workbench for ARM

Insert the IAR Embedded Workbench CD into the CD-ROM drive of the host PC. The setup program should start up immediately and install the necessary software. Otherwise the setup program (**.exe**) can be manually executed from the root folder of the CD.

- Install the IAR EWARM Evaluation tools, from the enclosed IAR Embedded Workbench CD, following the steps indicated in the install procedure.
- Alternately an evaluation version of the IAR EWARM software development software can be obtained from their website at <http://www.iar.com/> Go to *Downloads->Evaluation software*. IAR provides two different versions of the free evaluation software: the **30-day Evaluation Edition** or the **Kickstart Edition**. This QuickStart manual and the included demos assume that the **Kickstart Edition** for ARM Architecture is installed.

The **Evaluation Edition** is fully functional but can only be used for 30 days, beginning from the day that it is registered.

The **KickStart Edition** is not time limited, but can only generate a maximum of 32KB of code.

Both versions require a license. For the evaluation version and the KickStart version, please register online when obtaining the download. A license key will be sent to the email address listed in the registration.

3.1.3 Updating the Segger JLink Drivers

The drivers for the JLink must be current.

- Download the most recent USB Jlink driver from Segger at the following URL:
http://www.segger.com/download_jlink.html
- After unpacking the installation file run the setup program and follow the steps on the screen. Once the installation is complete browse to the following installation location:
C:\Program Files\Segger\JLinkARM_V350e
- Select and copy the files *jlinkarm.dll* and *jlink.exe*.
- Paste the files to the **bin** folder located in your IAR installation path:
C:\Program Files\IAR Systems\Embedded Workbench 4.0 Kickstart\ARM\bin
overwriting the existing files with the newer version.

3.1.4 Installing Device Files In IAR Embedded Workbench

Additional phyCORE-LPC3180 target-specific files for use with the IAR Embedded Workbench have to be copied into the IAR installation folder for proper execution of the demos provided with this Rapid Development Kit.

- Browse to **C:\PHYBasic\pC-LPC3180\Demos\VAR\Firmware** and copy the following files:

FlashPhytecLPC3180.d79
FlashPhytecLPC3180.mac
PhytecLPC3180BootL2.sim

into the installation folder for the IAR tools:

**C:\Program Files\IAR Systems\Embedded Workbench 4.0
Kickstart\ARM\config\firmware\Phytec**

- Next browse to **C:\PHYBasic\pC-LPC3180\Demos\VAR\Devices** and copy the following files:

PhytecLPC3180.i79
PhytecLPC3180.menu

into the installation folder for the IAR tools:

**C:\Program Files\IAR Systems\Embedded Workbench 4.0
Kickstart\ARM\config\devices\Phytec**

3.2 Interfacing the phyCORE®-LPC3180 to a Host-PC

Connecting the phyCORE-LPC3180, mounted on the phyCORE Carrier Board, to your computer is simple.

- Ensure proper jumper settings on the phyCORE Carrier Board as shown in *Figure 1*.

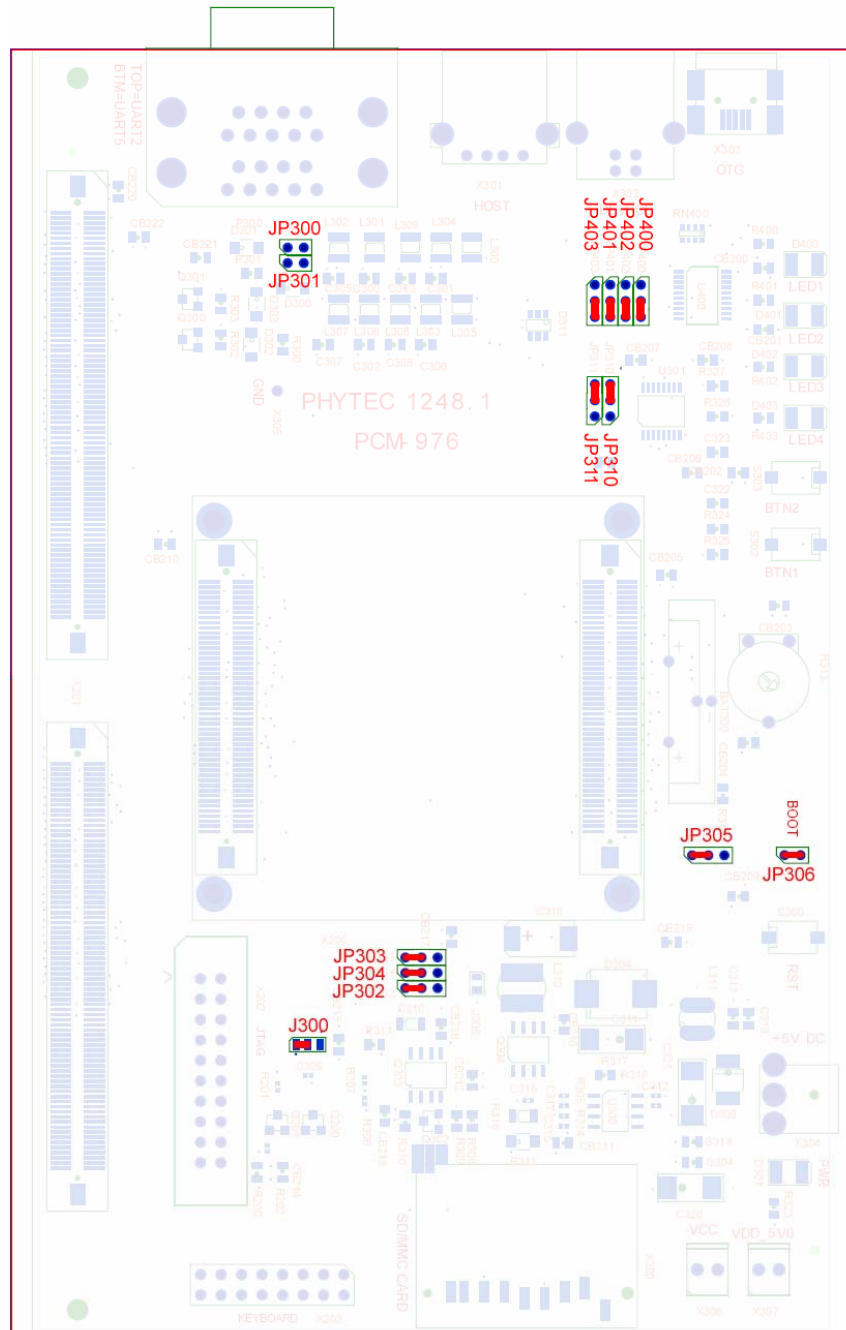


Figure 1: Default Jumper Settings of the phyCORE Carrier Board with phyCORE-LPC3180

- Connect the JLINK into the JTAG connector on the phyCORE Carrier Board (X202). Ensure that pin one of the connector on the Carrier Board denoted with the hash mark is matched with pin one of the JLINK denoted by the blue strip.
- Mount the phyCORE module, pins-down, onto the Carrier Board's receptacle footprint (X200) as shown in *Figure 2* below. Ensure that pin 1 of the module matches pin 1 of the receptacle on the Carrier Board. The JTAG PCB edge connector on the phyCORE-LPC3180 module will point towards the DB-9 connectors on Carrier Board.

Ensure that there is a solid connection between the module pins and the Carrier Board receptacle. Also take precautions not to damage the connectors when the phyCORE module is removed from and inserted onto the Carrier Board.

- Connect the USB end of the JLINK JTAG adapter to the USB port of your host-PC using the included USB cable.

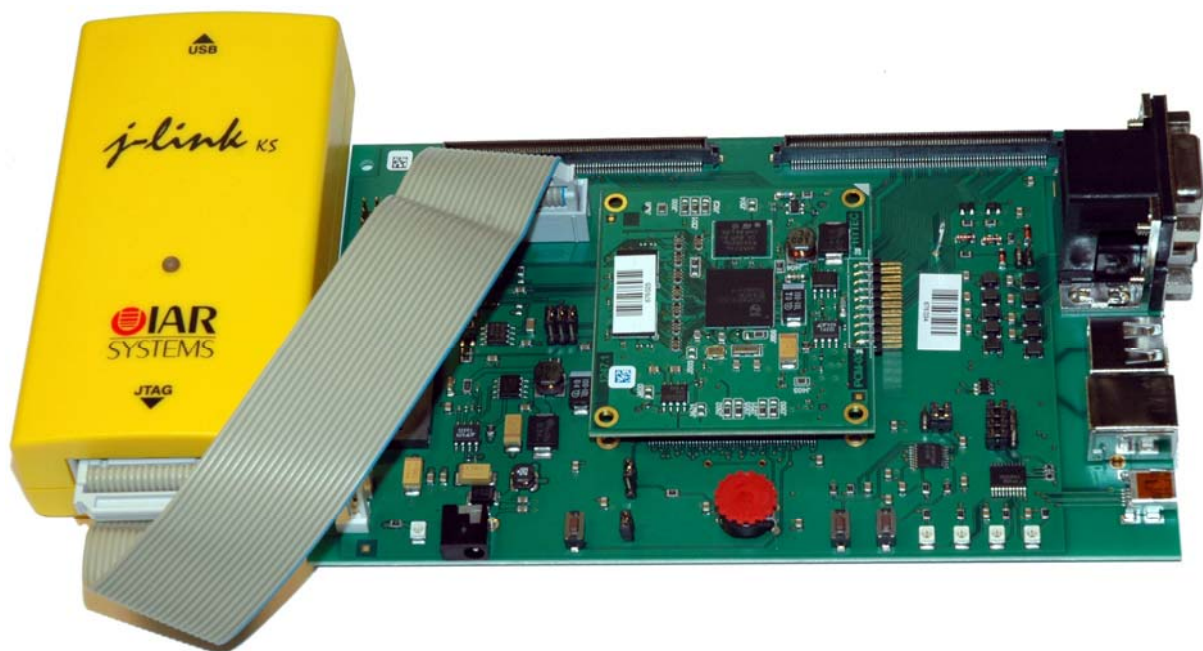


Figure 2: JLINK Connected to the phyCORE-LPC3180 Rapid Development Kit

- Connect the included 5V power adapter to the power socket X304 on the phyCORE Carrier Board (refer to *Figure 3* for the correct polarity).

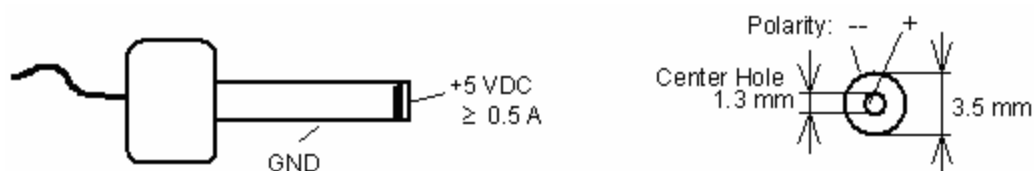


Figure 3: Power Connector

- The red power LED D307, located next to the power socket at X304, should illuminate. This indicates that proper voltage is supplied to the phyCORE module/Carrier Board combination (which is also referred to as "target hardware" within this document).

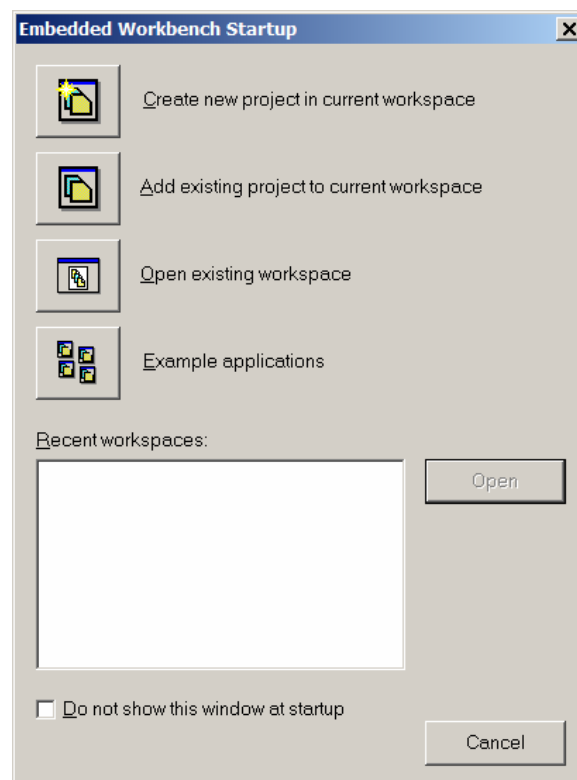
The phyCORE module/Carrier Board combination should now be properly connected to a host PC via the IAR JLINK. You are now ready to use the IAR EWARM tools to establish communication between the host-PC and target hardware.

3.3 Downloading Example Code with EWARM

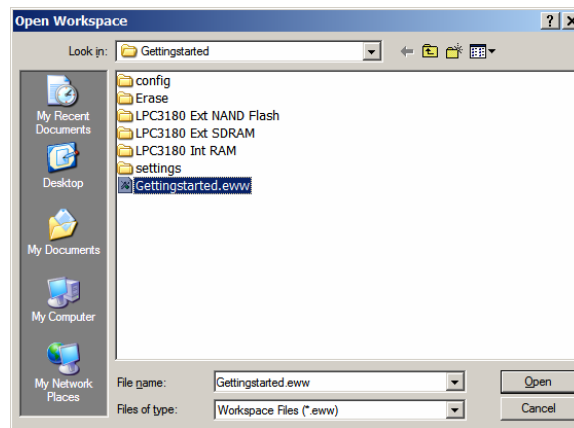
The IAR EWARM software development tool chain should have been installed as described in section 2.4.

- Start the Workbench by selecting IAR Embedded Workbench for ARM from within the programs group: *Start\Programs\IAR Systems\IAR Embedded Workbench for ARM Kickstart*.

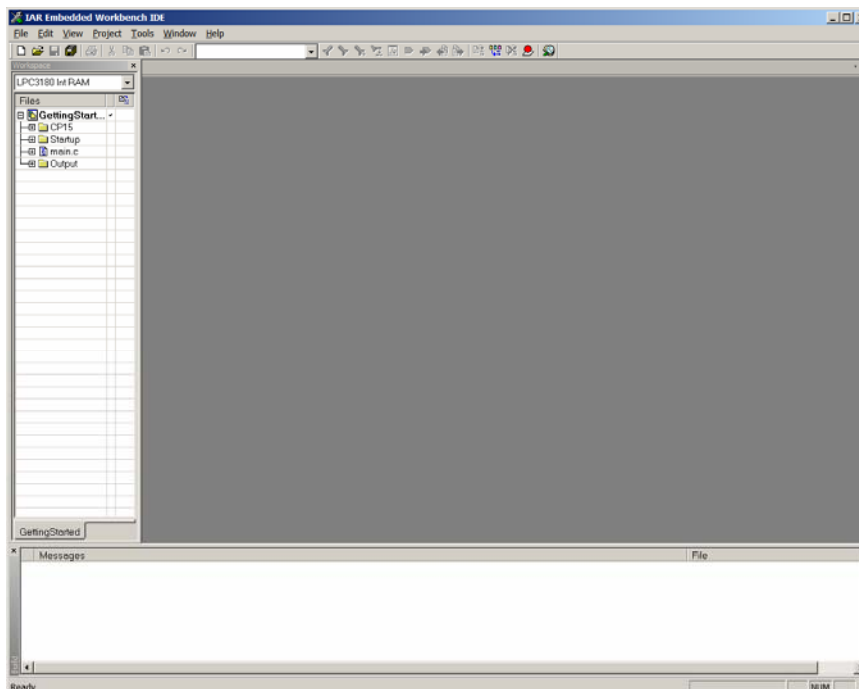
The *Embedded Workbench Startup* window will appear.



- Open the **Gettingstarted** workspace by choosing *Open existing workspace* from within the startup screen.
- Browse to the workspace located at: **C:\PHYBasic\pC-LPC3180\Demos\IAR\Gettingstarted**.
- Select the **Gettingstarted.eww** project and click *Open*.



- The project window will appear as follows:

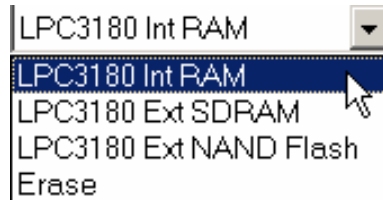


Within this workspace there are four targets:

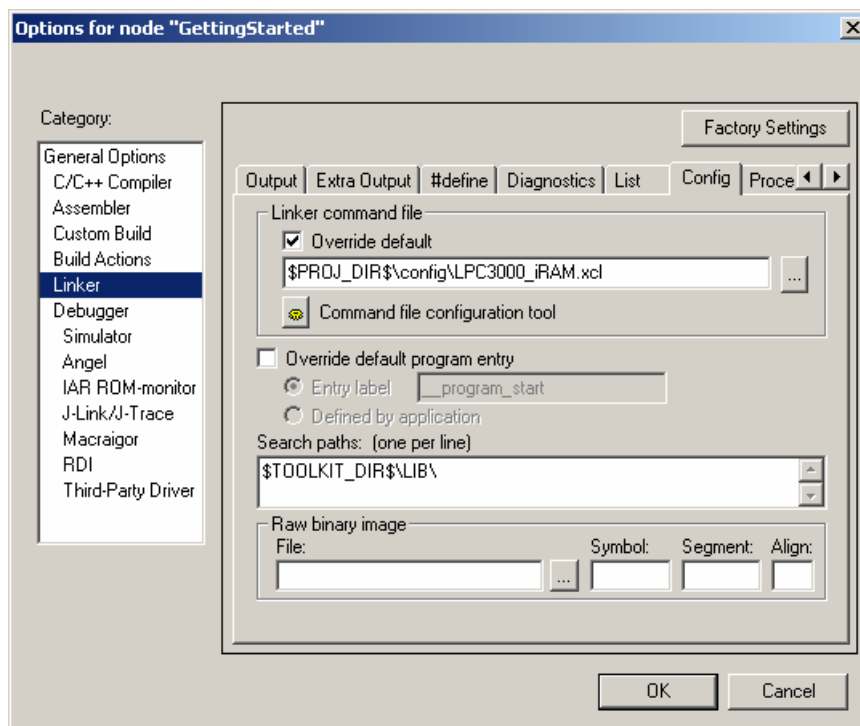
- 1) **LPC3180 Int RAM:** Loads code to LPC3180 Internal RAM
- 2) **LPC3180 Ext SDRAM:** Loads code to phyCORE-LPC3180 on-board SDRAM
- 3) **LPC3180 NAND Flash:** Loads secondary boot loader and application code to phyCORE-LPC3180 on-board NAND Flash
- 4) **Erase:** Erases the application code from the phyCORE-LPC3180 on-board NAND Flash

3.3.1 Downloading Code to Internal RAM

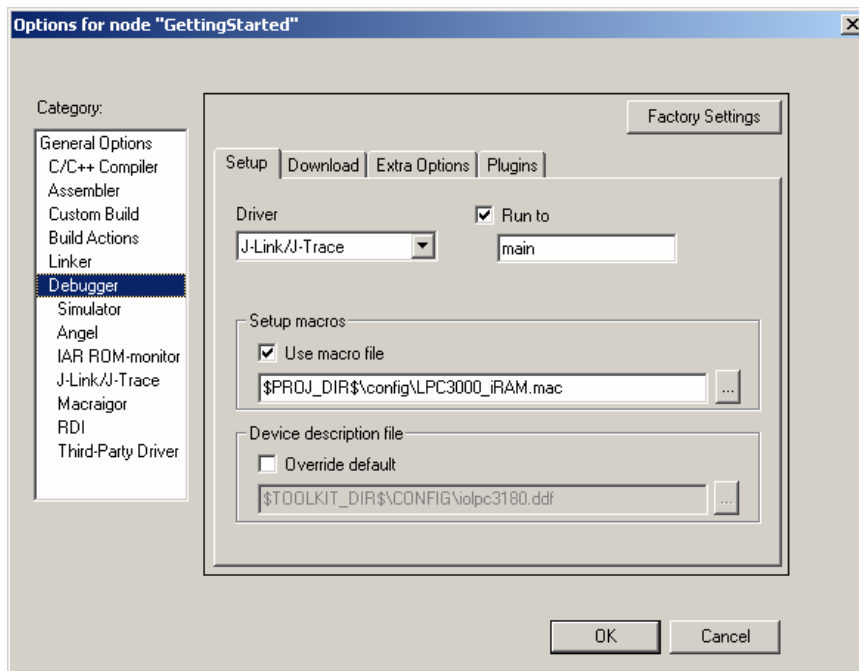
- In the **Workspace** window pull-down menu select the target *LPC3180 Int RAM*.




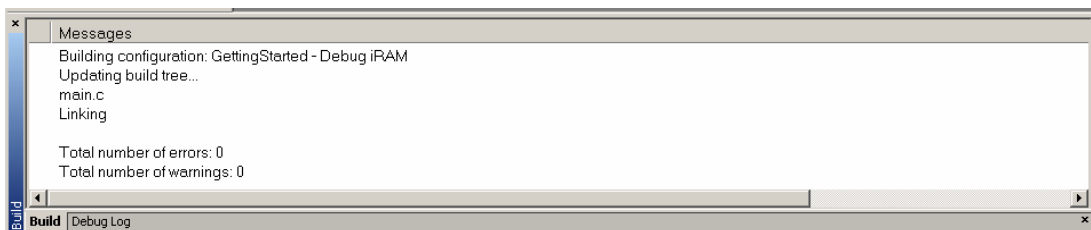
- This target will program the application code to the LPC3180 internal RAM.
- Select *Project->Options* from the toolbar.
- Select **Linker** from the *Category:* list and choose the **Config** tab.




- Ensure that the linker command file is set to ***\$PROJ_DIR\$\config\LPC3000_iRAM.xcl***. This file provides the necessary commands to map the code to the internal RAM on the LPC3180.
- Choose **Debugger** from the *Category:* menu and select the **Setup** tab.



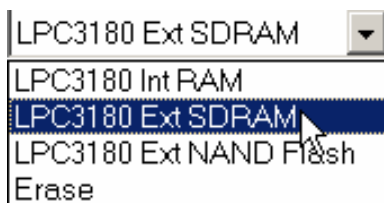
- Ensure that the J-Link/J-Trace driver is selected as the driver and the macro file is selected as ***\$PROJ_DIR\$\config\LPC3000_iRAM.mac***.
- Close the **Options** dialog box.
- Click on the **Make** button  to build the project. The result of the build is displayed in the **Build** dialog box.




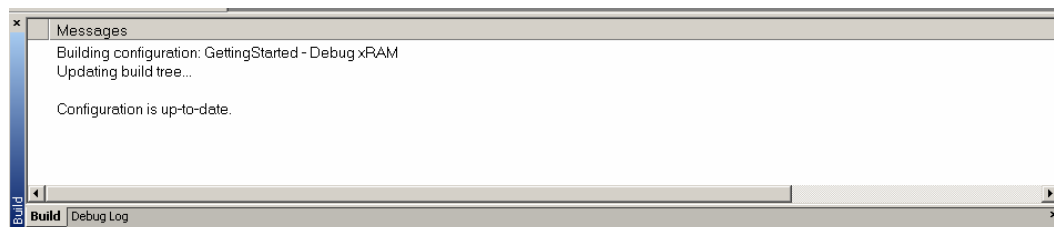
- Click on the **Debug** button  to start the debugger. The debugger will load the code into the internal 64 KB IRAM in the LPC3180.




3.3.2 Downloading Code to External SDRAM

- In the **Workspace** window pull-down menu select the target *LPC3180 Ext SDRAM*.



- This target will program the application code to the on-board External SDRAM.
- Select *Project->Options* from the toolbar.
- Select **Linker** from the *Category:* list and choose the **Config** tab.
- Ensure that the linker command file is set to ***\$PROJ_DIR\$config\LPC3000_xRAM.xcl*** This file provides the necessary commands to map the code to the correct location in the on-board SDRAM.
- Choose **Debugger** from the *Category:* menu and select the **Setup** tab.
- Ensure that the J-Link/J-Trace driver is selected as the driver and the macro file is selected as ***\$PROJ_DIR\$config\LPC3000_xRAM.mac*** This file provides the necessary commands to configure the registers and setup the on-board SDRAM before downloading the code to it.
- Close the options dialog box.
- Click on the *Make* button  to build the project. The result of the build is displayed in the *Build* dialog box.



- Click on the *Debug* button  to start the debugger. The debugger will load the code into the on-board 32 MB SDRAM on the the phyCORE-LPC3180.
- Click on the *Go* button  to execute the code from external SDRAM. The application code starts with LEDs LED_400/401 and LED_402/403 flashing on and off alternately.
- Push the S302 button (BTN1) on the Carrier Board (this is the push button closest to the red potentiometer dial) to see the blinking speed change.
- The standard debugging options xARE available on the debug toolbar to debug the application.
- Click on the *Stop Debugging* button  to exit the debugger.

3.3.3 Downloading Code to External NAND Flash

IAR provides a secondary boot loader for the NAND Flash. To better understand the reasons for the need of a secondary boot loader on the LPC3180 a concise explanation of the boot process is presented below.

After a reset the LPC3180 executes the on-chip bootstrap software located in the on-chip boot ROM. This software is responsible for reading code out of NAND Flash and loading it in internal RAM and executing it. Because the IRAM is limited to 64kB on the LPC3180, it is not possible to execute code out of internal RAM which exceeds 64kB in size. Furthermore, despite the presence of 64kB of IRAM in the LPC3180 the bootstrap software will only copy 15.5kB from the NAND Flash into IRAM for execution.

To get around this limitation code must be executed from external SDRAM which is much larger in size than internal RAM. In order to execute code out of SDRAM three basic steps must be followed:

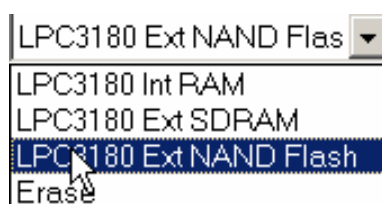
- (1) the SDRAM interface must be initialized, and
- (2) the code must be copied from NAND Flash into SDRAM, and
- (3) execution must be transferred to SDRAM.


The LPC3180 bootstrap software is not capable of initialization SDRAM, copying code from NAND Flash to SDRAM, and executing it. For this reason a secondary boot loader must be present on the LPC3180 target. The secondary boot loader must be located in block 0 of the NAND Flash from which the LPC3180 bootstrap software will load into IRAM and execute. This secondary boot loader will then initialize the SDRAM, copy application code from NAND Flash into SDRAM, and then transfer execution to SDRAM.



For a more detailed description of the boot process, please refer to the phyCORE-LPC3180 Hardware Manual.

Note: Bad block skipping is supported by the secondary boot loader provided with this Rapid Development Kit.

- In the **Workspace** window pull-down menu select the target *LPC3180 Ext NAND Flash*.

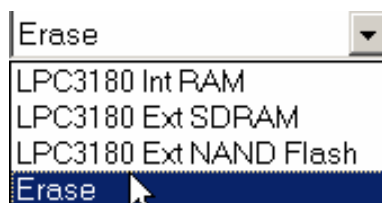




- This target will program both the secondary boot loader and the application code to the on-board NAND Flash.
- The **Linker** and **Debugger** settings for the *Ext NAND Flash* target are already set to configure the required values.
- Click on the **Make** button  to build the project. The result of the build is displayed in the *Build* dialog box.

- Click on the *Debug* button  to start the debugger. The code will be programmed into the on-board 256KB NAND Flash.
- Click on the *Stop Debugging* button  to exit the debugger.
- Press *Reset*. The application code starts with LEDs LED_400/401 and LED_402/403 flashing on and off alternately.
- Push the S302 button (BTN1) on the Carrier Board (this is the push button closest to the red potentiometer dial) to see the blinking speed change.

3.3.4 Erasing the NAND Flash

- In the **Workspace** window pull-down menu select the target *Erase*:



- Click on the *Debug* button  to start the debugger. EWARM will show that the Flash is being programmed, but no code is actually being loaded and in fact the NAND Flash is erased.
- Click on the *Stop Debugging* button  to exit the debugger.

The on-board NAND Flash is now erased. The LEDs may still blink, but this is because the code controlling the LEDs has been loaded into the external RAM and this is where it is still executing from. Once power is recycled the SDRAM will be cleared and the LEDs will remain off, indicating that the Flash erase was successful.

3.4 Creating a New Project

For ease of creating a new project for the phyCORE-LPC3180, it is recommended that the provided **Gettingstarted** project be used as a template. The **Gettingstarted** project already has the target, linker, compiler, debugger, and startup code correctly configured for the phyCORE-LPC3180. You can simply exchange or add your application-specific source code and recompile the project.

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Document number: L-689e_1, November 2006

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