ARM-Projects

by Martin THOMAS

Available Projects and Information (Content)

- You may like to visit my AVR-Projects page too.
- **WinARM**. The gnu-toolchain and several tools and samples for ARM controller/processors for MS-Windows-Platforms. (last Update 24. Apr. 2006)
- A short introduction into ARM-JTAG debugging **using Wiggler(-clones)** and the gnu-Debuggers (last Update 4. June 2005)
- OpenOCD as flash-programming Software (last Update 6. May 2006)
- A small demo for the LPC2106 and LPC2129 (ARM7TDMI) controllers - LED and button interfaceing (**GPIO**) (last Update 23. Feb. 2006)
- A small demo for the LPC2106 and LPC2129 (ARM7TDMI) controllers - LED and button interfaceing (GPIO) and **Timer-Interrupt**(via VIC) (last Update 17. May 2005)
- A small demo for the LPC2106 (ARM7TDMI) controller - **UART**-Programming (last Update 26. Oct 2004)
- A small demo for the LPC2106, LPC2129 and LPC2138 (ARM7TDMI) controllers - **interrupt-driven UART** (last Update 11. Oct 2005)
- Controller Area Network **(CAN) with Philips LPC2129** (last Update 17. May 2005)
- arm-elf-gcc and newlib **stdio**/"printf"-Interface and LPC2129 ADC example (last Update 17. May 2005)
- arm-elf-gcc Example Application with some **Functions in RAM** ("fastrun"/"ramfunc") (last Update 17. May 2005)
- **C++** with LPC ARM7TDMI/newlib/newlib-lpc (inheritance, polymorphism) (last Update 20. Aug. 2005)
- Port of the **Philips LPC213x/214x example-colletion for the gnu-toolchain** (last update 28. Apr. 2005)
- Interfacing Philips LPC2000 ARM7TDMI-S with **memory-cards** (SD/MMC) (last Update 31. May 2006)

- FreeRTOS example with LPC2138 (last Update 19. May 2006)
- **AT91SAM7S GPIO** Example (last Update 18. July 2005)
- **AT91SAM7S Timer interrupt** Example (last Update 31. Oct. 2005)
- **AT91SAM7S UART** Example (last Update 31. Oct. 2005)
- **AT91SAM7S GPIO/interrupt/UART** Example with a lot of "gcc specials" (last Update 3. Dec. 2005)
- **AT91SAM7S USB** Example (last Update 8. Nov. 2005)
- Interfacing ATMEL AT91SAM7S ARM7TDMI with **memory-cards** (SD/MMC) (last Update 4. Jan. 2006)
- GNU-Port of the Atmel "MIPS" example with "gcc/as specials" (last Updated 10. May 2006)
- AT91SAM7 SWI, Remap, GPIO, PIT and stdio Example (last Updated 19. May 2006)
- Analog Devices ADµC7000 ARM7TDMI controller Examples (last Update 19. Apr. 2006)
- Interfacing Maxim/Dallas **DS18x20 Temperature Sensors** with an LPC2106 (ARM7TDMI) (last Update 26. Nov 2004)
- Interfacing a **Graphics-LCD** with the LPC2106 (ARM7TDMI) (last Update 29. Oct 2004)
- **"T"-Clock**: DCF77 radio-clock-receiver with Graphics-LCD display for LPC2106 (ARM7TDMI) (last Update 23. Dec 2005)
- Machine-to-Machine (M2M) communication A **data-logger with GPRS**-connection (last update 1. Mar. 2006)
- A patched version of the ULINK Windows-driver (last Update 7. Sept. 2004)

"Last updated" may be just additional information not always a new version of a software-package. All presented LPC2106, LPC2129 and LPC2138 projects should work with minimal modifications in the linker-scripts and source-code on all Philips LPC2xxx controllers. Most of the code should also work on other ARM7TDMI controllers after small modifications.

If you think that I could help you with your projects: just send an e-mail. I'm looking for "freelance"-jobs.

You may also find useful code and information on my Atmel AVR-Projects page

If you send me an e-mail: Please use your full name (your _real_ full name). And it's always nice to get some kind of feedback if an answer to a question did help or did not help. I often spend a lot of time answering e-mails and would at least like to know if my suggestions did or did not help solving a problem.

Questions or suggestions? Please use the support-forum for WinARM/arm-elf-gcc and the example-projects.

WinARM

WinARM is a collection of GNU and other tools to develop software for the ARM-family of controllers/processors on MS-Windows-hosts. Unlike other collections WinARM does not depend on a cygwin or mingw-environment. All needed tools are in the distribution-package. WinARM has been tested with Philips LPC2106, Philips LPC2129, Philips LPC2138, Philips LPC2148 and Atmel AT91SAM7S64, AT91SAM7S256, AT91RM9200 ARM7TDMI(-S) controllers (the list is based on own tests and user feedback). The gnu-toolchain and the supplied tools should work with all microcontrollers based on ARM(-TDMI/Thumb etc.) architecture. WinARM has been made in the spirit of WinAVR which is a collection for Atmel AVR 8bit-Controllers.

WinARM includes in **Version 20060331**:

- GNU-C/C++-Compiler (cross compiler/linker/assembler arm-elf-*) Version 4.1.0 incl. stdlib3. Compiled from the FSF-Sources The configuration supports ARM-Mode, Thumb-Mode and Mixed(ARM/Thumb)-Mode, little/big-endian and floating point-emulation
- GNU-Binutils Version Version 2.16 (CVS snapshot 30.Mar.2006) FSF-Sources
- newlib Version 1.14.0 (build for reentrant syscalls)
- newlib-lpc Rel.5 (reentrant syscalls for newlib and Philips LPCs)
- GNU-**Utils** do support the compiler/linker (make, sh etc. from the mingw-project)
- ARM header-files (register-defintions) from gnuarm.org and others
- **Example applications** with full source-code, makefiles, linker-scripts and startup-code for Philips LPC2000, ADuC7k and Atmel AT91SAM7 ARM7TDMI controllers. More Examples on my ARM-Projects pages.
- Programmers Notepad Editor Version 2.0.6.1
- The lpc21isp in-system-programming-software for Philips LPC2xxx and the Analog Devices ADUC 70xx family by Martin Maurer. Included Versions: 1.31 and 1.37(BETA)
- Bray Terminal by Vlado Brajer
- Insight-GDB 6.4.50 - Win32-Native (devkitpro.org)
- GDB (command-line without Insight) Version 6.3.50.20051020-cvs from Codesourcery
- Setup-Exe of Macraigor's OCDRemote (Wigger-gdb interface, Ver. 2.16)
- Open On-Chip debugger (OpenOCD, SVN55) made by Dominic Rath

- H-JTAG (Ver. 20060313) made by "twentyone"
- J-Link gdb-Server V1.0 from the gnuarm yahoo-group

Planned extensions:

- Installer

User-Forum: A support-forum for WinARM/arm-elf-gcc and the example-projects. You are invited to visit this forum and ask questions or help others.

Download by right-click->save as, please download *only one* of the archives either the zip or the 7z. The contents is the same.
Download the WinARM 20060331 **zip**-Archive here (ca. 90 Megabytes, "Readme.htm" of this version).
The same version but packed with a different packer. Download the 7-Zip Archive here (just 41 Megabytes, unpacker available at 7-zip.org). Please respect all licenses of the included components. WinARM itself has no additional license.

Please *do not use download-managers with more than 5 parallel connections! (There are people who use >30 parallel connections.) Download only one of the archives (zip* ***or*** *7z). Is it that difficult to understand? Both archives have the same content, which has just been packed with a different methods. I will be forced to throttle the server and use traffic-shaping if this habbits do not stop.*

Alex Gibson kindly provides a **mirror-site** (winarm.alexthegeek.com).

- Precompiled OpenOCD SVN-Version 62 (zip, ca. 700kB, timestamp 20060524) - update for WinARM20060331.
- **old** Precompiled OpenOCD SVN-Version 59 (zip, ca. 700kB, timestamp 20060419) - update for WinARM20060331.

The **old** WinARM Version 20060117 with gcc 4.0.2 is still available. [Download] (zip, ca. 80 Megabytes, "Readme.htm" of this version). In case you have problems with make ("e=2", "file not found") with the **old** Version 20060117 please replace the complete WinARM/utils/bin directory with the one from the alternate-utilites for version 20060117. Take care: the make version 3.80 included in the archive is case sensitive even on MS-Windows systems, so filenames in the makefile have to be given in correct upper- and lowercase.

The **old** WinARM Version 20050209-2 with gcc 3.4.3, binutils 2.15.94, newlib 1.13 is still available. Download the **old** WinARM 20050202 zip-Archive here (zip, ca. 49 Megabytes) or here (tar.bz2, ca. 41 Megabytes).

LPC2106 and LPC2129 ARM7 GPIO example

This is a simple example to let a LED blink and test button-input (**GPIO**) on a Philips **LPC2106** (ARM7TDMI-architecture). The demo-board LPC-P2106 from Olimex has been used. The code itself is not very interesting but a makefile for GNUARM is included. The project is adapted for Windows platforms but since GNU-tools are used, the changes needed to use it on Unix/Linux are minimal. Please read the readme.txt and the comments in the source-code and the makefile for further information. Download the complete archive here. An updated version of this sample can be found in the WinARM sample directory

A blink-switch-example for the Philips **LPC2129**. Code prepared for a Olimex LPC-P2129 demo-board(*1) but can be adapted to other hardware easily. Tested with WinARM 4/05. [Download] (Timestamp 20040429)

Another blink-switch-example with a little **C++** support (just one class). The example has been made to verify the function of makefile, linker-scripts and startup-code. Code prepared for a LPC2106, tested with WinARM 2/05 and 4/05. [Download] (Timestamp 20050429)

LPC2106 and LPC2129 ARM7 GPIO and timer interrupt

example

This is a simple example to let a LED blink and test switch-input on a Philips **LPC2106** (ARM7TDMI-architecture). The delay for the blink-routines is timed by a **system-timer** which updates a "timebase" in an interrupt service routine (very much like the Blinky_IRQ sample from Keil GmbH). The demo-board LPC-P2106 from Olimex has been used. Please read the readme.txt and the comments in the source-code and the makefile for further information. The code and makefile are prepared to be built with WinARM but should be rather portable among other gcc-based toolsets. Download the complete archive here (timestamp 20050514, makefile (**with thumb-interwork-options**), headers, linker-scripts and startup-code included). Make sure to use a new version of arm-elf-gcc (>=3.3.1?) since the interrupt-code did not compile correctly in old gcc-versions. Code has been tested with gcc V4.0.0 (WinARM 4/05).

A similar example for the Philips **LPC2129**. Demonstrates timer-irq, VIC, thumb-interwork, linker-scripts, startup-code etc. Code prepared for the Olimex LPC-P2129 Rev A demo-board(*1) but can be adapted to other hardware easily. Tested with WinARM 4/05. [Download] (Timestamp 20050504)

Another Blinky-Example for the Philips **LPC2129**. This one is for the Keil MCB2100 evaluation board. Beside of the adaption for the Keil board this example includes an updated makefile and updated linker-scripts. The source-code has been extended and comments have been added. Tested with WinARM 1/06. [Download] (Timestamp 20060223)

LPC2106 ARM7 UART example

This sample-application demonstrates interfacing the ARM7-UART(0) in polled ("simple" non-interrupt) mode with a LPC2106 ARM7TDMI. Derived from open-source/free code by R O Software. The demo-board LPC-P2106 has been used. Please read the readme.txt and the comments in the source-code and the makefile for further information. The code and makefile are prepared to be built with WinARM but should be rather portable among other gcc-based toolsets. Download the complete archive here (timestamp 20041214, makefile, headers, linker-scripts and startup-code included). Code has been tested with arm-elf-gcc V3.4.2. Thanks to Murray Horn for reporting a bug in the PLL-Setup. Fix applied in 20041214.

LPC2106, LPC2129 and LPC2138 ARM7 interrupt-driven UART

This sample-application demonstrates interfacing the ARM7-UART(0) in "interrupt-mode" with a **LPC2106** ARM7TDMI-S. Adaption and slightly modified and extended version from open-source/free code by R O Software for the demo-board LPC-P2106. Please read the readme.txt and the comments in the source-code and the makefile for further information. The code and makefile are prepared to be built with WinARM but should be rather portable among other gcc-based toolsets. Download the complete archive here (timestamp 20041028, makefile, headers, linker-scripts and startup-code included). Code has been tested with arm-elf-gcc V3.4.2.

A similar example for the Philips **LPC2129** ARM7TDMI-S, tested with WinARM 4/05 (gcc 4.0.0). Download the complete source-archive here (timestamp 20050514).

A similar example for the Philips **LPC2138**. Demonstrates interfacing both UARTs, timer-irq, VIC, thumb-interwork, linker-scripts, startup-code etc. Code prepared for the Keil MCB2130 demo-board but can be adapted to other hardware easily. Tested with WinARM 8/05. [Download] (Timestamp 20051008)

LPC2129 CAN Example

This is just a port of the example "CANall V1.10" from Embedded Systems Academy to WinARM and the Olimex LPC-P2129 board(*1) (Philips LPC2129 ARM7TDMI-S). Some minor cleanup has been done in the CAN-code to avoid compiler warnings. Just connect CANL/CANH of both CAN channels and the on-board LEDs will blink. Tested with WinARM 4/05 (gcc 4.0.0). Download the complete source-archive here (timestamp 20050514).

Newlib/StdIO-Interface and LPC ADC example

This example-application demonstrates interfacing C-standard I/O ("printf") with the ARM7-UART(0). A minimal set of reentrant support functions for newlib's stdio and malloc is included. This code does not need newlib-lpc itself (some code of newlib-lpc has been copied into the source). It may be easier to port this code to other ARM-based controllers. Additionaly the demo-application includes a small example which shows how to interface the build-in analog-digital converter (ADC) of a LPC2129 (AIN0). Download the complete archive here (timestamp 20050514, makefile, headers, linker-scripts and startup-code included). Code has been tested with arm-elf-gcc V4.0.0 and a Philips LPC2129 ARM7TDMI-S on a LPC-P2129-board.

C++ with LPC ARM7TDMI/newlib/newlib-lpc

This example-application demonstrates C++ on ARM-controllers with the gnu/gcc-toolchain. The gnu libstdc++ is in use. The newlib and newlib-lpc provide the needed "low level" functions. C++ inheritance and polymorphism are implemented in this example. Target is a Philips LPC2129 ARM7TDMI-S but the code should be rather portable as long as a gnu/gcc-toolchain is used and libstdc++ is supported for the target. Code, linker-scripts and makefile have been tested with WinARM (4/05). Download the complete source-archive here (timestamp 20050820, makefile, headers, linker-scripts and startup-code included, newlib and newlib-lpc (including headers) must be provided by the build-environment - as done by WinARM. (update: added *extern "C"*). (old Version 20050513 here)

Run selected Functions in RAM with arm-elf-gcc

This example-application demonstrates how to set-up the compiler and linker to execute selected functions from RAM. Shown in this example:

- Declare functions in RAM (section attribute)
- Declare functions to be called by a "long-call" (long-call attribute)
- Linker-script-entries for the "function-section"
- Startup-code which transfers the function-code from ROM to RAM

Target for this example is a Philips LPC2129 ARM7TDMI-S but the code should be rather portable as long as a gcc-toolchain is used. Code, linker-scripts and makefile have been tested with WinARM (4/05). Download the complete source-archive here (timestamp 20050510, makefile, headers, linker-scripts and startup-code included).

Philips LPC213x/214x examples ported for the GNU-Toolchain

A ported version of the Philips LPC213x/LPC214x example "code bundle" to the GNU-toolchain (arm-elf-gcc) can be found on this page.

FreeRTOS example for LPC2138

An example for the LPC2106 on the Olimex LPC-P2106-board comes with the FreeRTOS-code. This is a ported version of the example to the LPC2138. The LED-handling has been adapted to the Keil MCB2130 evaluation-board. The code has been tested with WinARM 3/06 (arm-elf-gcc 4.1.0). [Download] (timestamp 20060519, zip-Archive, ca. 200kBytes).

AT91SAM7 Examples

On my AT91 projects page you can find:

- A GPIO example application for the Atmel **AT91SAM7S64** (should work with all AT91SAM after minimal changes) which demonstrates usage of the general IO (LEDs/Buttons).
- An AT91SAM7 interrupts example which demonstrates "AIC"-interrupts by a timer and an external interrupt.
- An AT91SAM7 Serial-IO/UART example for the Atmel **AT91SAM7S64** (should work with all AT91SAM after minimal changes) which demonstrates UART interfacing (serial I/O) in simple "polled" mode (no ISRs).
- An AT91SAM7 Serial-IO/UART and interrupt example for the Atmel **AT91SAM7S64** (should work with all AT91SAM after minimal changes) which demonstrates UART interfacing (serial I/O), interrupt/exception-handling and lots of gcc-specials.
- Example application for the Atmel **AT91SAM7S64** (should work with all AT91SAM7S after minimal changes) which demonstrates USB and UART interfacing (USB access via system-Driver/DLL, "pseudo modem" and virtual COM-port)
- An interface for the Embedded-Filesystem-Library and AT91SAM7S-controllers (AT91SAM7S64 et al). To read and write data to SD/MMD memory-cards
- GNU-Port of the Atmel "MIPS" example with "gcc/as specials"

- AT91SAM7 SWI, Remap, GPIO, PIT and stdio Example

All AT91 projects are now on my AT91 projects page

Analog Devices ADµC7000 ARM7TDMI controller Examples

Please visit my ADI ARM-controller page.

Using OpenOCD as flash-programming tool

A short introduction on how to use OpenOCD as flash-programming tool can be found on this page.

Patched Version of the Keil ULINK Windows-Driver

I've got the Keil ULINK debugging-inferface togehter with the MCB2100 evalation board. The ULINK-driver on the CD included with the kit and the updated version of the driver available on the Keil Web-Site (written: 7.9.2005) did not work on my development-machine (Windows2000SP4+Rollup, old Intel "BX" board, USB1.1 onboard hostchip). I've spent some hours with this and even installed an additional PCI-USB-Card with a NEC USB 2.0 controller. But the problem is not caused by the hardware. Only a modified inf-file solved this issue. With this inf-File the ULINK could be used with the 1.1 and 2.0 USB-Ports. Get the inoffical inf-File here(zip-Archive, ca. 19kB, Timestamp 20050824).

Update: Keil has fixed the inf-file. An official version is available from keil.com (search the knowledge base for ulink driver).

LPC2106 ARM7 Interfacing with Maxim/Dallas Onewire Temperature Sensors (DS18x20)

This sample-application demonstrates interfacing Maxim/Dallas DS1820/DS18S20/DS18B20 with a LPC2106 ARM7TDMI controller

using the Onewire-interface. The code detects all DS18x20 sensors on a bus and sends information via UART/RS232. Tested with a Philips LPC2106 at FOSC=14,7MHz/CCLK=58MHz. Timing has to be very precise for Onewire. This preliminary code still has a "tuning value" (see delay.h). Based on the AVR code. Code is not very "clean" since it has just been a test during the "T-Clock" development. Download the ARM7 source code here (Timestamp 20041114, makefile for WinARM and hex-file for the LPC-P2106 board included, 1-Wire Pin: P0.4).

LPC2106 ARM7 connected to Graphics-LCD

This sample-application demonstrates interfacing a KS0108/KS0107 graphics-LCD with a LPC2106 ARM7TDMI. Based on the "LPC2106 interrupt-UART"-sample (see above) which has been extended with a glcd-module. Find out more on this page.

"T"-Clock: ARM7 Radio-Controlled-Clock with Graphics-LCD

This sample-application demonstrates interfacing a KS0108/KS0107 graphics-LCD, Onewire Temperature-Sensor and a DCF77 time-signal receiver with a LPC2106 ARM7TDMI. Find out more on this page.

(*) Remark about Olimex ARM Demo-Boards: Please verify that the definitions for connected hardware (like LED, Buttons etc.) in the source-code match the connections on the demo-board in use. Olimex produces different versions of the boards and sometimes the version is not obvious. If in doubt: measure the connections. I have the Olimex LPC P-1 which has been replaced by the LPC-P2106 and the LPC-P2129 which has been replaced by the LPC-P2129-B. Both successor boards differ from the old boards. I.E.: Buttons on LPC-P2129 are connected to P0.10 and P0.11 on the LPC-P2129_B they are connected to P0.15 and P0.16. (Thanks to Chris "O2" for the information about the P2129-B-Board.)

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