Linear Technology DC934A Linux Application User's Guide for use with the Altera Cyclone V SoC Development Kit

Revision 1.0

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Introduction

The DC934A Linux application demonstrates access to the Linear Technology DC934A demonstration circuit, featuring the LTC2607 dual 16-bit DAC, from the Altera Cyclone V SoC evaluation board. The DC934A Linux application allows the user to configure the LTC2607 to output different voltage levels and to read back these levels using the on-board LTC2422 dual-channel ADC.

Board Connections

The following picture illustrates the hardware connections for the DC934A and the Altera Cyclone V Evaluation Board. The DC934A is connected to the Altera Cyclone V SoC Evaluation board using the QuikEval header, J32.



Figure 1. Hardware Connections

Jumper Settings

Configure the jumper settings of the Altera Cyclone V SoC evaluation board as per Appendix A. Board Setup of the Altera SoC EDS User Guide.

Installing Linux

Configure the Altera Cyclone V SoC evaluation board to run Linux as per *Appendix B. Running Linux* of the *Altera SoC EDS User Guide*.

Install the GPIO Kernel Modules

Install the Linux kernel modules necessary for controlling the GPIO. This will need to be performed after every boot. From the Linux console of the development board, run the following commands:

- % cd /lib/modules/3.7.0/kernel/drivers/gpio
- % insmod gpio-generic.ko
- % insmod gpio-dw.ko

DC934A – Linux Application Debugging

This section presents how to debug the DC934 Linux application using ARM DS-5 Altera Edition and the provided DC934A Linux application.

Importing the DC934A Application

- 1. Start Eclipse for DS-5
- 2. Go to File->Import...
- 3. In the Import window, select General -> Existing Project into Workspace and press Next
- 4. Choose **Select Archive File** option and browse to the directory containing **Linear-DC934-Linux.tar.gz** and select it.
- 5. Press **Finish** to complete importing the DC934A application.

At the end of the import process Eclipse will show the project files:

- DC934.c DC934 application source code
- LTC2422.c LTC2422 ADC related source code
- LTC2422.h LTC2422 ADC header file
- LTC2607.c LTC2607 DAC related source code
- LTC2607.h LTC2607 DAC header file
- UserInterface.c Helper code for the user interface
- UserInterface.h Header file for the user interface
- Makefile Makefile used to compile the DC934 application

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Figure 2. Linux DC934 Application Files

Compiling DC934A Application

The DC934A application is compiled in Eclipse by going to **Project -> Build Project**. This will compile the project using the Linaro gcc suite for Linux, which is part of the SoC EDS.

After a successful compilation, the following files will be created:

- DC934.o object file
- LTC2422.o object file
- LTC2607.o object file
- UserInterface.o object file
- dc934 executable file
- dc934.map linker output map file

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Figure 3. Compiled Project

Setting up Remote System Explorer

The ARM DS-5 AE can run and debug programs directly on the target with the help of the RSE (Remote System Explorer). Before this feature can be used, the RSE needs to be configured to connect to the target board running Linux.

Before doing the steps presented in this section, the board must be connected to the network and have an assigned IP address. Also there has to be a valid username with a password on the Linux board. This can be achieved by assigning a password to the root account, which does not have a password set up by default. 1. Within the desired Eclipse workspace, go to **Window -> Open Perspective -> Other**

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Figure 4. Other Perspective

2. In the Open Perspective window, select the **Remote System Explorer** and click **OK**.

| Open Perspective | | | |
|---|----|------|--|
| C/C++ (default) CVS Repository Exploring Debug DS-5 Debug Java Java Browsing Java Type Hierarchy PyDev Remote System Explorer Resource Team Synchronizing | | | |
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Figure 5. RSE Perspective

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- 3. Within the RSE view, right click Local and select New- > Connection ...

Figure 6. New Connection

4. Select Remote System Type to be SSH Only and click Next

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Create a new resource

| New Connection | |
|---|--------|
| Select Remote System Type Connection for SSH access to remote systems | _ |
| System type: | |
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| ✓ General ♣ FTP Only ▲ Linux ➡ Local ➡ SSH Only Unix Unix ֎ Windows | |
| ? < <u>Back</u> <u>Next ></u> <u>Finish</u> | Cancel |

Figure 7. Remote System Type

5. Enter the IP address of the board in the **Host Name** field, and also give the connection a name and a description. Click the **Finish** button to have the connection created.

| New Connection | | | | |
|--|-----------------|----------------|----------------|--------|
| Remote SSH Only Define connection i | System Connect | ion | | |
| | | | | |
| Parent profile: | Maria-Laptop | | | • |
| | | | | |
| Host name: | 192.168.202.162 | | | • |
| Connection name: | 192.168.202.162 | | | |
| Description: | DevKitLinux | | | |
| Verify host name | 1 | | | |
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Figure 8. Connection Parameters

6. Click the **DevKitLinux -> Sftp Files -> Root**. This will open up a window to enter the username and password. Use root for username and the password you have set up for it.

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| Local Shells | 39 #include <stdint.h></stdint.h> | 🛀 stdlib.h |
| 192.168.202.162 | 41 #include <string.h></string.h> | String.h ≡ |
| To Sttp Files | 42 #includ | unistd.h |
| | 43 #includ | LTC2607.h |
| Pending | 45 #includ System type: SSH Only | LTC2422.h |
| 📑 Ssh Shells | 46 Host name: 192.168.202.162 | # MANUAL_SW |
| 🎜 Ssh Terminals | 48 #define User ID: root | 🕂 print_title() : v |
| | 49 Decement (entional) | ++ print_prompti |
| | 50 // Func | ++ prompt_volta |
| | 52 void pr | (anonymous) |
| | 53 int16_t Save password | + get_voltage(ii |
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Figure 9. Enter Password

7. Eclipse will ask for confirmation of authenticity of the board. Press Yes.



Figure 10. Board Authenticity Confirmation

8. RSE will then show the files currently on the DevKit board on the left panel.

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| □ Connection: 192.168.202.162 - Ho | ost name: 192.168.202.162 - | Description: Dev | /KitLinux | | | | |

Figure 11. Target Files Visible

Debugging DC934A Linux Application

At this stage we have a compiled DC934A Linux application and a properly configured Remote System Explorer. This section will show how to create a Debugger Configuration and use it to run and debug the application.

- 1. Go to Run->Debug Configurations
- 2. Right-click the DS-5 Debugger and click New
- 3. Name the new Debugger Configuration **DevKitLinux-DC934**
- 4. In the **Connection** Panel
 - Select the target to be Altera -> Cyclone 5 -> Linux Application Debug -> Download and Debug Application.
 - Select the newly created RSE connection and keep the default values.

| Debug Configurations | |
|--|--|
| Create, manage, and run configuration | |
| [Files]: No target download directory detai | Is entered |
| Yes Yes type filter text C /C++ Application C /C++ Attach to Application DS-5 Debugger New_configuration Part Application Ion Python Run Ion Python Run Ion Python Run Ion Python Run Ion Python nun Java Applet Java Applet Ion Python nun V Jython run V Jython nun V Jython Run PyDev Django PyDev Dogago Python Run Python Application | Name: DevKitLinux-DC934 Image: Connection Image: Debugger Image: Arguments Image: Environment Image: Event Viewer Select target Select the manufacturer, board, project type and debug operation to use. Currently selected: Altera - Cyclone V Image: Imag |
| | Connections RSE connection 192.168.202.162 (DevKitLinux) dddress: gdbserver (TCP) Port: 5000 Use Extended Mode |
| Filter matched 19 of 19 items | Apply Reyert |
| ? | Debug Close |

Figure 12. Debugger Connection Settings

- 5. Go to Files tab, and
 - Select the Application on host to download to be the **dc934** executable file. Use the **Workspace** ... button to browse for the application.
 - Select the target download directory
 - Select the target working directory

| Debug Configurations | | × |
|--|---------------------------------|---|
| Create, manage, and run configurations Create, edit or choose a configuration to laur | s nch a DS-5 debugging session. | - |
| Ype filter text € C/C++ Application € C/C++ Attach to Application € C/C++ Remote Application € D-5 Debugger New_configuration Iron Python Run Iron Python Run Iron Python Run Java Applet Java Application Julnit Jython run Jython nunittest PyDev Django PyDev Google App Run Python Run Python Run | Name: DevKitLinux-DC934 | |
| Filter matched 19 of 19 items | ApplyRevert | |
| ? | Debug Close | |



6. On the Debugger tab, make sure the **Debug from symbol** is selected and the symbol name is **main**.

| Debug Configurations | | x |
|--|------------------------------|---|
| Create, manage, and run configurations Create, edit or choose a configuration to lau | ch a DS-5 debugging session. | - |
| Image: Second Secon | Name: DevKitLinux-DC934 | |
| Filter matched 19 of 19 items | Apply Re <u>v</u> ert | |
| ? | Debug Close | |

Figure 14. Stop At main

7. Click the Debug button. Eclipse will ask to switch to Debug perspective. Press Yes.



Figure 15. Switch to Debug Perspective

8. Eclipse will download the application to the board and stop at main, as instructed.



Figure 16. Application Downloaded

 At this stage all the usual debugging features of DS-5 can be used: breakpoints, view variables, registers, tracing, etc. Click the **Continue** green button or press **F8** to run the application. The DC934A application's menu will be printed on the App Console in the lower right portion of the screen.



Figure 17. Application Running

10. To set a DAC value, activate the App Console by clicking on it and enter a **3** for the *"Write and update DAC"* command. Then enter a **1** to specify a voltage level and then **2.5** for 2.5V.



Figure 18. Setting a DAC Value

11. The, output voltage level of the DAC can be read using the ADC. Enter a **6** for the *"Read ADC"* command and the application will read and display the voltage levels for both channels. You may have to scroll back in the App Console window to see the output values.



Figure 19. Reading a ADC Value