STM32-Primer

Fun, easy introduction kit for STM32 microcontrollers

User Manual

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RAISONANCE

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1.Presentation

The STM32 Primer is an innovative, low-cost evaluation and development package that is designed to provide a fun and easy introduction to the features of the STM32 with ARM Cortex™-M3 core.

The Primer's ergonomic design with MEMS-based controls (navigate by tilting the tool left, right, backward or forward) and LCD display provide fun and easy control of the included demonstration firmware that includes graphical user interface and games based on the resources of the STM32 microcontroller.

The included firmware (CircleOS task scheduler, system services and demonstration applications) implements low level functions driving the various STM32 peripherals. In addition, it includes features for dynamic loading and management of new applications. All firmware, demos (C sources and projects) and more future applications are available for free download at the STM32-Primer dedicated site, http://www.stm32circle.com/.

The Primer and Ride7 software toolset provide everything needed for programming the STM32 and debugging applications, including:

- USB host connection for in-circuit programming and debugging

- Ride7 integrated development environment for code editing, device programming and application debugging (debug up to 32K of code, with included version. For information about upgrade to an unlimited version of Ride, visit http://www.stm32circle.com/resources).

- GNU C /C++ compiler (unlimited compiling)

2. The STM32 Primer hardware

2.1. List of Contents

You will find when opening the box:

- The STM32-Primer in its plastic case,
- A USB cable for host PC connection that can be used to program and debug the STM32 microcontroller. Alternatively this cable can be used to communicate with the STM32-Primer if you program a USB client application.
- A CD-ROM containing Ride7 for ARM and all the STM32-Primer documentation.

2.2. Description
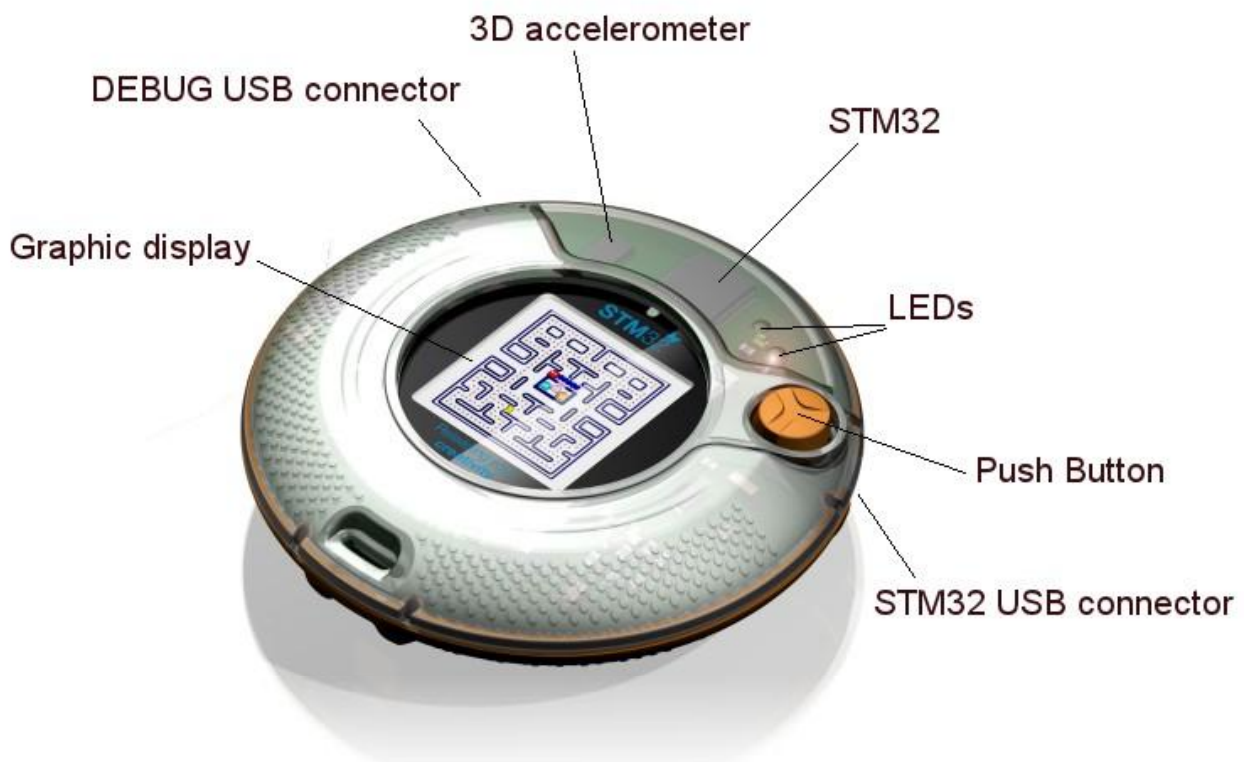
The STM32-Primer provides the following devices:

- An LCD color monitor (64K colors, 128x128 pixels),
- 2 USB connectors:
  - One marked "Debug" to connect to a PC running Ride for application development,
  - One marked "STM32" that allows the embedded application to communicate with an external USB host.
- One push button to switch on the power supply and to launch menu commands,
- One accelerometer (MEMS) that captures the 3D-position information related to the STM32-

Primer, and which is used to navigate through the menus, and to move the pointer.

- Note that 2 footprints on the printed circuit could receive some optional interface components:

- One IrDA transmitter (top side, close to the "Debug USB port") that allows communication between two STM32-Primer,

- One extra connector is linked to some unused I/O pins of the STM32 in order to add extra peripherals.

Opening the plastic case of the STM32-Primer is easy (no screw, no clip). Just separate the two halves of the case and remove the board.

2.3. STM32 microcontroller features

The STM32-Primer is equipped with an STM32F103B6, one of the new ST, Cortex-based, 32-bit microcontrollers. The main characteristics of this device are:

- ARM 32-bit Cortex™-M3 CPU, 72 MHz, 90 DMips with 1.25 DMips/MHz,

- 128KB of Flash program memory, 20KB SRAM,

- Embedded oscillators (for high-speed quartz + RTC),

- SWD and JTAG debug interfaces,

- Fast input/output: up to 80 IOs, ADC, DAC,

- Embedded communication peripherals: USB 2.0, CAN, USART, SPI, I2C, LIN,

- Multiple timers; watchdog, PWM, Systick timer, ...

2.4. 3D accelerometer

The STM32-Primer is equipped with a MEMS inertial sensor (LIS3LV02DL from STMicroelectronics). This device is used by the STM32-Primer as a human interface device to select commands, in coordination with a graphic pointer. When you start the STM32-Primer for the first time, you will see a small ball moving according to the orientation of the STM32-Primer circuit. The information about the 3D position is provided by the MEMS.

You will find complete documentation of the 3D accelerometer on the companion CD-ROM. Examples are provided that allow evaluation of various functions of the MEMS usage.

2.5.Power supply

The STM32-Primer features a 2.4V rechargeable battery.

The following figure shows the general principle of the power supply schematic (the complete STM32-Primer schematics are available in appendix A):
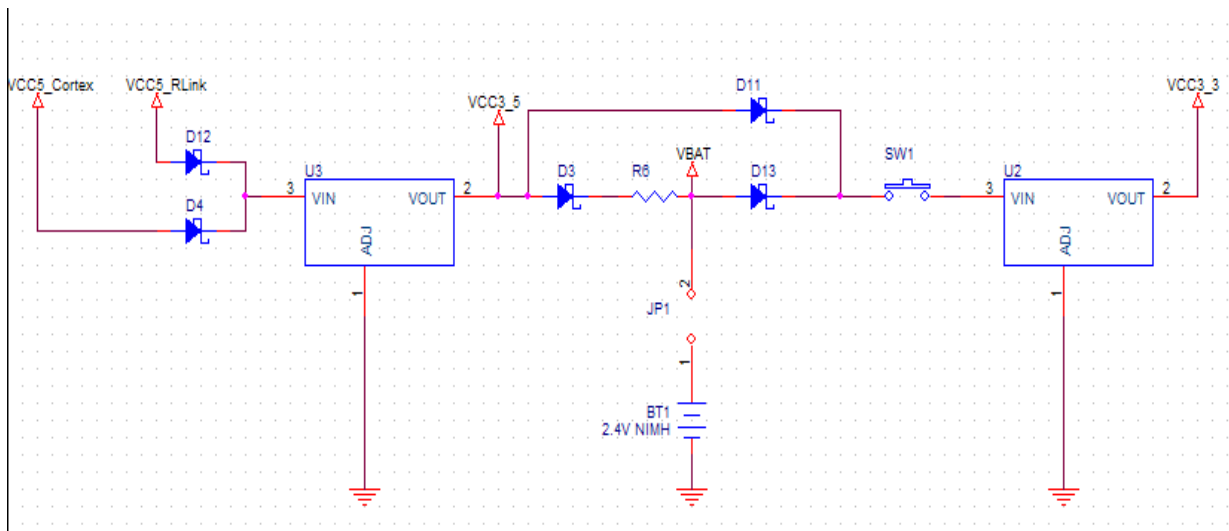
When one USB connector is linked to a PC host (either the RLink or the STM32), the 5V voltage supplied by the PC is used to recharge the batteries.

When no USB host is connected, the battery is used to supply the power for the STM32-Primer. When the batteries are fully charged, the Primer can be used for about 2 hours.

The duration of the batteries depends on the Primer activity. For instance, it can be extended -or reduced- by changing the setting of the backlight intensity (see the menu "Settings").

Note: The battery load mechanism of the STM32-Primer is limited. It just applies a voltage to the battery in order to charge it, without any control over the delivered current. This is enough for demonstration and evaluation purposes, but this should not be applied to a project intended for commercialization. Full recharging of the battery takes 16 hours and it is recommended to remove the battery jumper after charging if your Primer will remain connected to your PC for application development.

2.6.For further information…

This document describes the STM32-Primer, basic use and its hardware and firmware features. Further information about tools intended for use with the Primer may be found in:

- "LIS3LV02DL MEMS Inertial Sensor Data Sheet", available from http://www.st.com/.
- "STM32F103 Performance AC Line", available from http://www.st.com/.
- "STM32F10x Flash programming manual", available from http://www.st.com/.
- "STM32F10x advanced ARM-based 32-bit MCU reference manual", available from http://www.st.com/.
- "STM32F10x Datasheet", available from http://www.st.com/.
- The "Cortex-M3 Technical Reference Manual" document describes the Cortex-M3 Core,

and is available directly from http://www.arm.com/.

- "ST7637 Datasheet". This document describes the 65K 132x132 color dot matrix LCD controller/driver, and is available from http://www.sitronix.com.tw/.

- The "PZG15BW-SCLW.pdf" document describes the characteristics for the 128x128 display of the STM32-Primer. This document is available from your Ride7 environment.

- The full GNU Compiler Collection (GCC) manuals are available from the Ride7 environment.

Please visit the Circle community web site at http://www.stm32circle.com/ for more resources.

3.Getting started

3.1.Connect battery, charge and power up

1. Open the Primer's case by pulling the top and bottom halves of the case apart. There are **no** catches or releases that hold the case together.
2. Fit the jumper so that it straddles the two pins to connect the power supply.
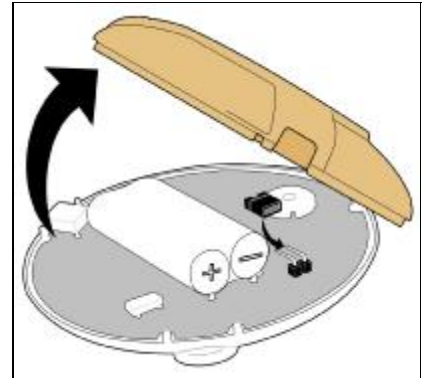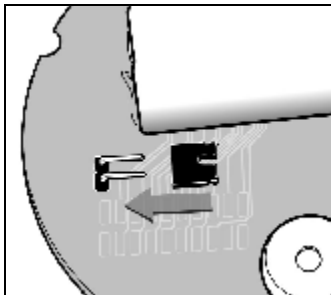
3. Close the case.
4. Connect the Primer to the USB port on a PC to charge its battery.
5. After charging the battery, press the push button to activate the Primer.

3.2.Play

1. After the opening screen is displayed, press the push button to call the main menu.
2. Tilt the Primer backward/forward to navigate in the menu, use the push button to select a menu command. Initial menu items include:

Config - Configure parameters for the Primer including the pointer, backlight for the LCD display and time

Maze - Start the maze game. Note that this menu item depends on the application that is selected in "Applic"

Applic - Select an application to run. The application that you choose will then appear in the main menu.

Shutdown - Turn off the Primer. To restart the Primer, simply press the push button.

Note: When you receive the Primer, the MEMS based controls are calibrated to a "zero" position that matches a 30° angle from the horizontal (corresponds to the position of a book when reading). To practice controlling the Primer, move the blue dot around the main screen. It takes a little practice.

Preinstalled applications
The Primer includes pre-installed applications:

- **Maze** – A game where the player navigates inside a labyrinth, eating dots to win points while avoiding ghosts

- **Breakout** – A game where the player uses a paddle to bounce a ball against a wall of blocks, destroying the block to win points. Win the game by destroying all the blocks.

- **Configuration** - Configuration and test applications have been pre-installed in order to check your STM32-Primer's capabilities. From the main menu of the STM32-Primer, launch the "Config" command. The following parameters can be set:

- o **CPU Freq**. This lets you choose the speed of your STM32-Primer.
- o **Backlight**. This lets you tune the backlight intensity. Note that the backlight is the main source of power consumption (with the LCD monitor itself). Reducing the backlight intensity allow to extend the duration when Primer is powered by the battery.
- o **Time**. This sets your STM32-Primer time. Note that the RTC clock will remain valid even if your STM32-Primer is shut off.
- o **Test**. This performs a quick factory test of the STM32-Primer.

You can add more applications to your STM32-Primer by downloading them on the web site www.stm32circle.com/projects. Refer to the chapter "4.4 Managing applications on your STM32-Primer".

3.3.Install the Ride7 software toolset for ARM

The CD-ROM contains many resources to help you evaluate the STM32 family:

- The RLink driver that needs to be installed in order to program/erase the applications.

- Ride7, the Raisonance IDE to write and debug new applications.

- The complete GNU software toolchain based on the GCC compiler, which is fully integrated into Ride7.

- Some utilities to manage your Circle applications (Circle is the OS embedded on your STM32-Primer; refer to Chapter4.1 "CircleOS architecture" for details).

- Documentation: Datasheets, user manuals for the different components of the STM32-Primer.

To install:

1. Insert the Raisonance mini CD-ROM on your PC, a menu will appear.

2. Select "Install ARM Toolset" from the menu. It will install all the required resources on your PC, including the RLink driver required for connection on the "Debug" USB port of your Primer.

Note: Install Ride7 before connecting to this USB port.

3.4.Modify an STM32 application example

In this chapter, we will modify an example installed with the "Ride7 Kit ARM". This example can be loaded in Ride7 using a shortcut placed in the Start Menu.

The example full path is:
"*[RIDE7_INSTALL_DIR]\Examples\ARM\Primer\STM32\toggle_with_CircleOS\toggle_with_CircleOS.rprj*"

It makes use of the CircleOS operating system provided as a library (circle.elf) that is described in the next chapter.

Follow these instructions to modify the example:

1. Open the example:

   Start > Programs > Raisonance Tools > Ride7 > STM32-Primer > STM32-Primer Startup Project

   Plug the Primer (Debug USB port) into the PC using the USB cable and follow the Windows USB installation.
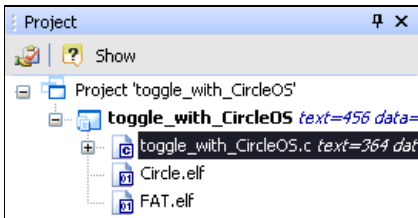
2. Launch the Debug mode:

3. Run the program:

   In the main menu on the Circle choose "toggle". As you can see, the application just toggles the green led to red. Now we will modify the program to make the buzzer beep at each led toggle…

4. Exit the debug mode:

5. Open the toggle example C file

Just double-click on the "toggle_With_CircleOS.c" in the project window.

6. Add in the code:

```
if(toggle_count >= MAX_TOGGLE_COUNT)
    {
    toggle_count=0;

    CurrentLedMode = (CurrentLedMode == LED_ON) ? LED_OFF : LED_ON;

    LED_Set ( LED_GREEN,CurrentLedMode);
    LED_Set ( LED_RED,!CurrentLedMode);
    BUZZER_SetMode(BUZZER_SHORTBEEP);
    }
```

7. Launch the Debug mode:

8. Run the program: