EvoPrimer for STM32F Performance MCU

Fun, easy introduction kit for STM32F103VE and STM32F103VG microcontrollers

User Manual

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Contents

1. Introduction

The EvoPrimer for STM32F Performance Line is a fun, cost-effective evaluation and development package based on Raisonance's versatile, innovative Open4 platform and STM32F103VE target board.

Note: The ST product EvoPrimer for STM32F Performance Line (ST order code: STM3210EPRIMER) is a derivative product of the Raisonance Open4. The same EvoPrimer target boards, extension boards, software tools and sample applications are used with both EvoPrimer and Open4.

Note: This documentation has been designed for STM32F103VE target boards. However, the STM32F103VG target boards are very similar to the VE boards, except that the memory size has been extended (1 MB of flash and 96 KB of RAM)

1.1 Purpose of this manual

This manual provides an overview and installation procedure for your EvoPrimer. Armed with the knowledge in this manual users can quickly understand the target microcontroller's features and create their own applications.

1.2 Scope of this manual

This manual is applicable to all versions of EvoPrimer for STM32F Performance Line. It describes the EvoPrimer's basic use and its hardware and firmware features. Further information can be found in:

- “LIS3LV02DL MEMS Inertial Sensor Data Sheet”, available from http://www.st.com/.
- “STM32F103 Performance AC Line”, see http://www.st.com/.
- “STM32F10x Flash programming manual”, see http://www.st.com/.
- “STM32F10x advanced ARM-based 32-bit MCU reference manual”, see http://www.st.com/.
- “STM32F10x Datasheet”, see http://www.st.com/.
- “Cortex-M3 Technical Reference Manual” describes Cortex-M3 Core, see http://www.arm.com/.
- “ILI9325 Datasheet” describes the 262K color single-chip TFT controller/driver, see http://www.ilitek.com/.
- “LCM-TGG000240YP04-24 Model.pdf” describes the 320x240 display of the EvoPrimer base.
- The GNU Compiler Collection (GCC) manuals are available from the Ride7 environment.

Visit the Circle community web site at www.stm32circle.com for more resources and software tool downloads.

1.3 Additional help or information

Please visit the Raisonance website: *http://www.raisonance.com/* and the forum *http://www.raisonance.com/Forum/punbb/* or contact Raisonance.

Address: Raisonance S.A.S.
17, Avenue Jean Kuntzmann,
38330 Montbonnot Saint Martin
France

Telephone: +33 4 76 61 02 30

Fax: +33 4 76 41 81 68
Email: ***support@raisonance.com***

If you find any errors or omissions, or if you have suggestions for improving this manual, please let us know by email.

2. Presentation

Your EvoPrimer is composed of two major hardware elements:

- a base platform,
- a target board featuring an STM32F103VE.

When the target board is connected to the base, the STM32F103VE drives the base's hardware features for evaluation purposes.
When the base is connected to a PC the target microcontroller can be reprogrammed and application software can be created and debugged using the Ride7 Raisonance software tools.

The target board also includes additional features that can be implemented in user applications, in addition to the features provided on the base.

The following sections describe the features of the base and target board, software tools and basic procedures for their use.

EvoPrimer

2.1 Base features

The base provides the following capabilities:

- USB debug/programming connection (SWD for STM32)
- QVGA (320x240) backlit color LCD, with touchscreen capability
- Joystick/push button (mechanical)
- 4 push buttons (based on touchscreen capability)
- MicroSD card connector
- Audio circuit with microphone/loudspeaker/jack
- 3D MEMS accelerometer
- Li-Ion battery with charge management circuitry
- Add-on connector (USART, SPI, I2C, ADC,...)

2.2 Target board features

The STM32F103VE target board integrates the following hardware features:

- STM32F103VET6 microcontroller (512KB Flash, 64KB RAM)
- USB device / host port
- Dual CAN ports on terminals

2.3 Development software

The development software offered with the EvoPrimer provides everything you need to program an STM32F and debug 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 64K 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)
- CircleOS operating system and base services. An online community available at http://www.stm32circle.com makes it possible to share your EvoPrimer experience with others on the forums, retrieve useful resources, application notes, firmware, demos (C sources and projects) and applications, all available for free download.

3. EvoPrimer hardware

3.1 Package contents

Your EvoPrimer unit has been carefully packed. Examine the equipment for damage that may have occurred during shipment. If you find any damage, or if any of the items are not included, please contact Raisonance.

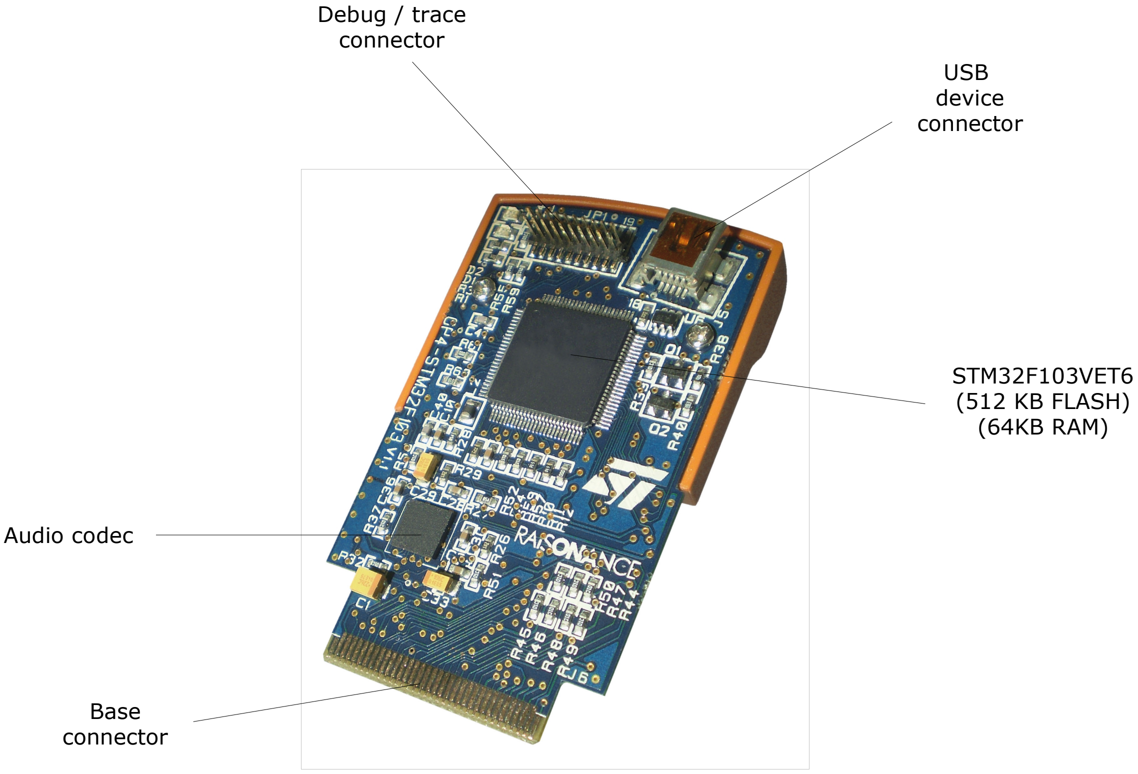
Your EvoPrimer is delivered in two packages:

1. EvoPrimer base with USB cable.
2. STM32F103VE target board.

Note: Download software tools after free registration at www.stm32circle.com

3.2 Components overview

Here is a brief overview of the main components of the STM32F103VE target board:



3.3 Target board features

3.3.1 STM32F103VE microcontroller features

The target board is equipped with an STM32F103VET6 from STMicroelectronics' STM32F Performance Line of 32-bit ARM Cortex-M3 core-based microcontrollers.

Its main characteristics are:

- ARM 32-bit Cortex™-M3 CPU, 72MHz, 90DMips with 1.25DMips/MHz,
- 512KB Flash program memory, 64KB SRAM,
- Embedded oscillators (for high-speed crystal + RTC),
- SWD debug interface,
- Fast input/output: up to 80 I/Os, ADC, DAC,
- Embedded communication peripherals: USB 2.0, CAN, USART, SPI, I2C, LIN, IrDA, SDIO,
- Multiple timers; watchdog, PWM, Systick timer, …

3.3.2 CAN

The STM32F103VC target board includes one CAN port which is compliant with specifications 2.0A and B (active) with a bit rate up to 1 Mbit/s.

Note: By default the CAN transceiver is not soldered on the board.

3.3.3 Audio codec

The STM32F103VE target board includes and audio codec component (Ref. STW5094A) which supports voice quality audio features of the base (recording and playback).

3.3.4 Mini-USB connector

The STM32F103VE target board includes a Mini-USB connector which can be used for USB 2.0 implementation in demonstration and user applications.

3.4 Base features

3.4.1 3D MEMS accelerometer

The base is equipped with a MEMS inertial sensor (LIS3LV02DL from STMicroelectronics) which can be used to select commands in coordination with a graphic pointer. When you start the EvoPrimer for the first time, you will see a small ball moving according to the orientation of the EvoPrimer. The information about the 3D position is provided by the MEMS.

3.4.2 Power supply

The EvoPrimer base features a 400mAh Li-Ion rechargeable battery, equipped with a voltage regulator and a battery charger.

When the USB connector is linked to a PC, the host voltage (supplied by the PC) is used to recharge the battery. When no USB host is connected, the battery supplies the power for the EvoPrimer. When the battery is fully charged, the EvoPrimer can be used for about 6 hours. The duration of the batteries depends on the activity.

3.4.3 Extension connector

The base has a 20-pin HE14 female right-angle extension connector that you can access when removing the orange part of the case. The mechanical description of the extension board is available in the “resources” section of the www.stm32circle.com web site.

The extension connector permits usage of the following pins:

Pin	Printed name	STM32 pin	STM32 name	Description
1	V2V8	Vcc	VCC	Connected to the output of the U6 regulator (3.1V). This source could provide approximately 100mA to the extension board.
2	GND	GND	GND	Ground
3	SCL	PB.6	CX_I2CSCL	Can be used either as a standard GPIO or considered as an alternate function: - I2C1_SCL (clock) - TIM4_CH1 - USART1_TX (if remapped)
4	SDA	PB.7	CX_I2CSDA	Can be used either as a standard GPIO or considered as an alternate function: - I2C1_SDA (data) - TIM4_CH2 - USART1_RX (if remapped)
5	MISO	PB.4	SPI3_MISO	Can be used either as a standard GPIO or considered as an alternate function: - SPI3_MISO / I2S3 (Serial Data) - SPI1_MISO (if remapped) - TIM3_CH1 (if remapped)
6	SD	PB.5	SPI3_MOSI / I2S3_SD	Can be used either as a standard GPIO or considered as an alternate function: - SPI3_MOSI / I2S3_SD (Serial Data) - SPI1_MOSI (if remapped) - TIM3_CH2 (if remapped)
7	SCK	PB.3	SWO	Can be used either as a standard GPIO or considered as an alternate function: - SPI3_SCK / I2S3_CK (clock) - SPI1_SCK (if remapped) - TIM2_CH2 (if remapped) Note that SWO is also connected to the embedded RLink for debug traces. This feature must be disabled when SPI3 or I2S3 is used with the extension board.
8	WS	PA.15	JTDI_I2S3_WS	Can be used either as a standard GPIO or considered as an alternate function: - I2S3_WS (Word Select) - TIM2_CH1_ETR (if remapped)
9	CANH		CX_CANH	

Pin	Printed name	STM32 pin	STM32 name	Description
10	CANL		CX_CANL	Connected to the CAN transceiver. When the CAN transceiver is not soldered, these pins could be easily connected to PB.8-PB.9 on the STM32 by shortcutting the signals on the footprint of the CAN transceiver.
11	ADC1	PC.4	CX_ADC1	Can be used either as a standard GPIO or considered as an alternate function: ADC12_IN14
12	ADC2	PC.5	CX_ADC2	Can be used either as a standard GPIO or considered as an alternate function: ADC12_IN15
13	A_TIM	PB.0	CX_ADC_TIM	Can be used either as a standard GPIO or considered as an alternate function: - ADC12_IN8 - TIM3_CH3 - TIM1_CH2N (if remapped)
14	CTS	PA.0	CX_USART_CTS	PA0/WKUP/ADC IN0Can be used either as a standard GPIO or considered as an alternate function: - WKUP - USART2_CTS - ADC12_IN0 - TIM2_CH1_ETR
15	RTS	PA.1	CX_USART_RTS	Can be used either as a standard GPIO or considered as an alternate function: - USART2_RTS - ADC12_IN1 - TIM2_CH2
16	TX	PA.2	CX_USART_TX	Can be used either as a standard GPIO or considered as an alternate function: - USART2_TX - ADC12_IN2 - TIM2_CH3
17	CK	N/A	P_BUTTON	Push button input. Can wakeup the extension board.
18	RX	PA.3	CX_USART_RX	Can be used either as a standard GPIO or considered as an alternate function: - USART2_RX - ADC12_IN3 - TIM2_CH4
19	VEXT	N/A	VBAT	Base battery voltage provided
20	GND	VSS	GND	Ground

Notes: Printed names on the extension board may not accurately match the pin names that exist for the STM32F103VE target board because the base is a generic design that supports other processor families (namely STM8) which do not share the same feature set as STM32. If you need CAN connectivity, you must solder a CAN transceiver (model MAX3051ESA from Maxim). Its footprint is identified on the picture below.

On Pin 7, SWO is used for ITM debug traces, for “printf” like functionality, thanks to the embedded RLink of your EvoPrimer base. SWO must not be enabled in your Ride7 project if you need to use SPI3 or I2S3 through the extension connector.

The following picture shows the footprint for the (unsoldered) CAN transceiver. It is located on the bottom side of the board, under the plastic case.

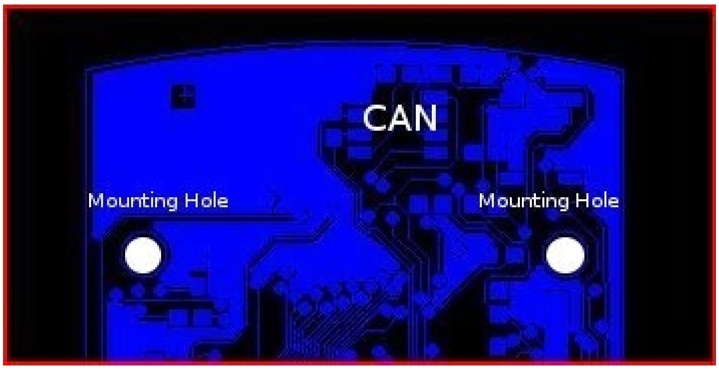
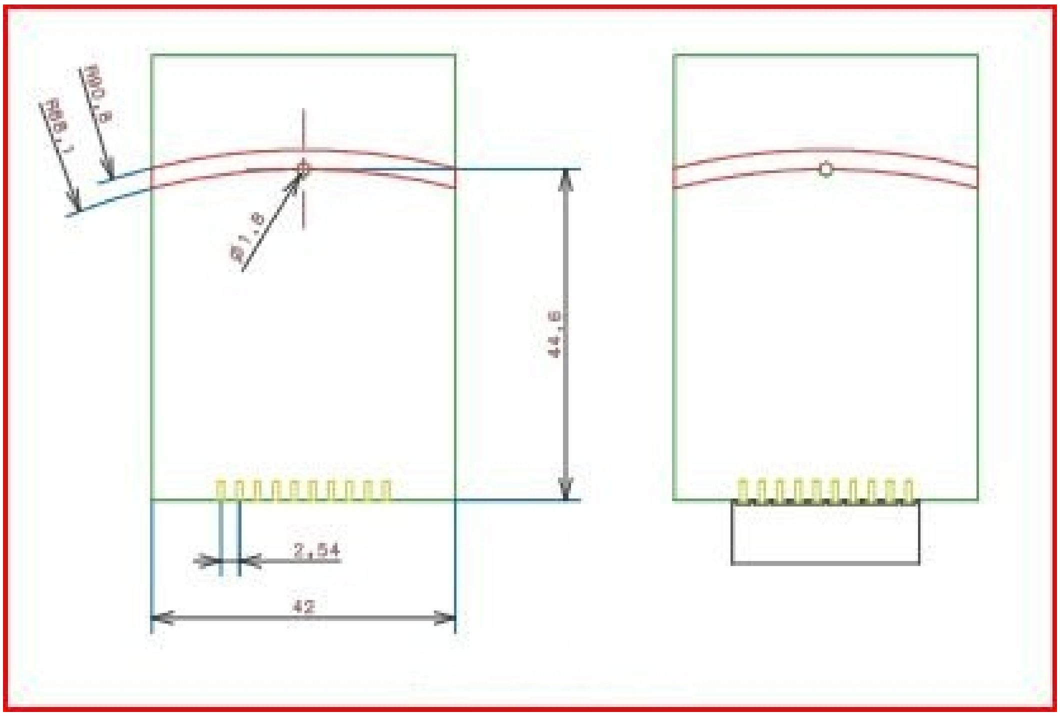


Illustration 3.1: CAN transceiver footprint

3.4.4 Application-specific extension boards

The base has been designed to be extended through application-specific extension boards. Such extension boards connect to the extension connector and are compatible (mechanically and electronically) with the previous STM32-Primer2, so you should be able to reuse your previous designs without modification to the extension board. However, some limitations may apply, for instance if you use specific processor/peripheral capabilities that are not portable between designs. The following picture shows the mechanical constraints that you should respect to ensure that your extension board fits inside the EvoPrimer case.



Extension board mechanical specifications

4. Getting started

This chapter explains how to switch on your EvoPrimer and describes the provided applications.

4.1 Switch on

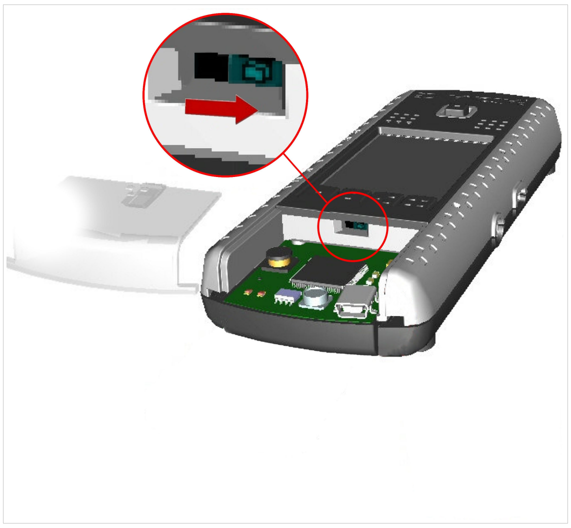
The procedure for getting started is reduced to four simple operations:

1. Insert a target board into the EvoPrimer base (see below).
2. Switch the power switch to provide current to the target board (see below).
3. Slide the transparent cover in place.
4. Press the joystick to power up the EvoPrimer.

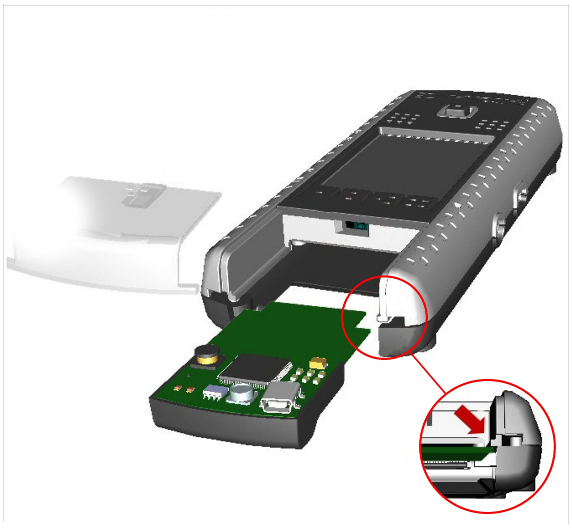
4.1.1 Insert the target board

The first thing to do is to insert the target board:

1. Remove the transparent cover.
2. Switch off the battery (see image below left).
3. Insert the target board into the base, as shown in the image, ensuring that the PCB is against the guides.
4. Push until the top of the target board fit with the side of the base.



Switching OFF the EvoPrimer

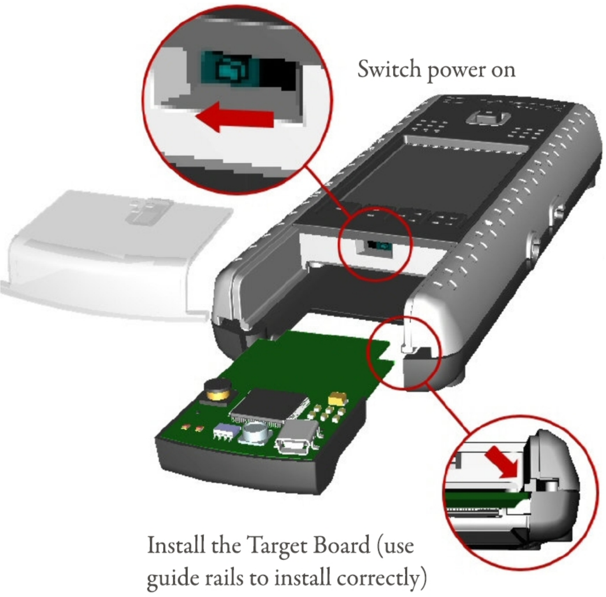


Inserting the target board

4.1.2 Connect battery, charge and power up

Your EvoPrimer is initially shipped with the battery disconnected in order to prevent discharging or harm occurring to the battery. You need to connect the battery before operating your EvoPrimer:

1. Open the EvoPrimer's case by removing the cover which is on the target board.
2. Switch the button as shown on the image to power on your device.
3. Close the case.
4. Connect the EvoPrimer to the USB port on a PC to charge its battery. Only the red LED (L0) will be lit if the battery is charging. The green LED (L1) is lit when fully charged.
5. After charging the battery, press the push button to activate the EvoPrimer.


Switch power on
Install the Target Board (use guide rails to install correctly)

4.2 Using your EvoPrimer applications

The base provides user interface features such as a color touchscreen, audio circuit, MEMS accelerometer-based navigation, joystick, push buttons, GUI, SD card connector, IrDA and much more.

The target board operates evaluation features when connected to the base, and includes additional features such as audio codec and a USB connector.

4.2.1 Play

After the opening screen is displayed, press the push button to call the main menu.

Tilt the EvoPrimer backward/forward or use the joystick to navigate in the menu, use the push button to select a menu command. Initial menu items include:

Config	Configure parameters for the EvoPrimer including the pointer, backlight for the LCD display and time.
Maze	This is an addictive game provided as an example. Full source is available from www.stm32circle.com.
Applic	Select an application to run. The application that you choose will then appear in the main menu.
SD card	Display information saved on the SD card, or allows to configure your EvoPrimer as a mass storage device, and transfer files from/to your PC from/to the SD card.
About	Display information about the CircleOS version and available memory.
Shutdown	Turn off the EvoPrimer. To restart the EvoPrimer, simply press the push button.
Quit	Quit the menu.

Note: When you receive the EvoPrimer, 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 EvoPrimer, move the blue dot around the main screen. It takes a little practice.

4.2.2 Preinstalled applications

The EvoPrimer includes preinstalled 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.
- **Gobang** – An Othello like game.
- **Square** – A game where the player must avoid meeting moving squares.
- **Graphics** – Application that shows the drawing capabilities of the EvoPrimer.
- **Kaleidos** – Transforms your EvoPrimer to a kaleidoscope.
- **Drummer** – Transforms your EvoPrimer in a musical beatbox. Shows the audio and touchscreen capabilities of the EvoPrimer.
- **Cubic-4 –** Last step of the tutorial, that transforms your EvoPrimer to a bubble level system.
- **Mouse –** Uses your EvoPrimer as a mouse for your PC.
- **COMMTEST** – Tests the USB com port, the joystick, and the MicroSD card connector.
- **EchoIrDA** – IrDA echo application, which makes it easy to connect your EvoPrimer to another IrDA appliance such as a cell phone or another EvoPrimer.

4.3 Configuration menu

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

1. **Power**:
   CPU Freq:. Chooses the speed of your EvoPrimer.
   Backlight: Tunes 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 the EvoPrimer is powered by the battery.
2. **Interface**:
   User input: Selects the user input for commands menu (accelerometer or joystick or accelerometer + joystick or touchscreen)
   Loudspeaker: enables or not the loudspeaker. If not, the sounds are only sent to the jack headphones connector.
   Menu: Selects whether or not to display the menu with a large font.
   Beep: Selects whether or not to send a "beep" when the EvoPrimer is tapped twice.
   TS Calibrate: Launches a calibration procedure of the touchscreen.
3. **Autorun**: The current application runs whenever your EvoPrimer is started. In this mode, there is no need to select the application in order to start it.
4. **Time**: Sets your EvoPrimer time. Note: the RTC clock remains valid even if your EvoPrimer is shut-off.
5. **Test**: Performs a quick factory test of the EvoPrimer.

You can add more applications to your EvoPrimer by downloading them on the web site www.stm32circle.com/projects. Refer to the chapter 5 Managing your CircleOS applications

4.4 Compiling, programming and debugging

4.4.1 Install software

To explore, modify and create new applications on your EvoPrimer you need to install some software:

1. Register and download the CD-ROM-Image file on the Resource page of www.stm32circle.com.
2. Extract the files and install:
    - **Ride7**, the Raisonance IDE to write and debug new applications. This includes the RLink driver which is necessary to pilot the programming and debugging of your EvoPrimer from your PC.
    - **RKit-ARM**, the Ride7 add-on that contains the complete GNU software toolchain based on the GCC compiler.
    - Some utilities to manage your Circle applications (Circle is the OS embedded on your EvoPrimer; refer to Chapter5.1 "CircleOS architecture" for details).
3. Launch Ride7.
4. Connect your PC to the Debug USB port on the base.

Complete tool documentation is provided with the software installation.

Note: Ride7 should be installed *before* connecting to this USB port.

4.4.2 Explore the STM32 Toggle application

Some examples are installed with the RKit-ARM for Ride7. For instance, this Toggle example will help you build and program a very simple EvoPrimer application:

“[RIDE7_INSTALL_DIR]\Examples\ARM\Primer\STM32EvoPrimer\toggle_STM32E\toggle.rprj”

Follow these steps in order to execute the example on your EvoPrimer :

1. Open Ride7.
2. Select **Open | Project** and navigate to the example.
3. Click on **Project | Make Project**.
4. Once the project is built, connect your EvoPrimer to your PC through USB.
5. Click **Debug | Start**.
6. Once the debugger is ready, you can run the example through **Debug | Run**.

You can then play with the sample application on your EvoPrimer.

5. Managing your CircleOS applications

5.1 CircleOS architecture

The STM32F103VE target board is equipped with an STM32F103 that contains 512KB of Flash ROM and 64KB of RAM. The EvoPrimer embeds the CircleOS operating system (source files are available from http://www.stm32circle.com/ after free registration). It provides services that will help you develop your STM32F EvoPrimer applications, including:

1. Application management,
2. LCD graphic functions,
3. MEMS functions,
4. LED, Buzzer and Push Button functions,
5. Menu functions,
6. Scheduler task,
7. Audio functions,
8. File system functions,
9. ...

CircleOS can load several independent applications.

Each application is run by CircleOS when selected, has the full availability of the CPU and can use all the RAM that is not being used by CircleOS (i.e. 16KB in the memory address range from 2000000h to 20003FFFh). It is scheduled by the CircleOS with full privileges on the device, until it explicitly quits.

5.2 The CircleOS Scheduler

CircleOS acts in several stages: An initialization stage which occurs upon device reset, a periodic Systick interrupt, and the scheduling of applications.

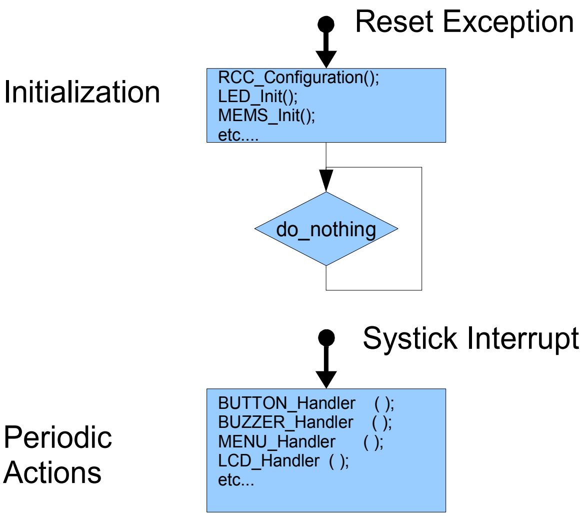
5.2.1 Initialization stage

During the initialization stage, the hardware configuration is performed, and the periodic system timer (Systick) is installed.

The Systick period depends on the RCC settings: it can be modified through the menu **Config | CPU Speed** to the following predefined values:

Level	CPU freq (MHz)	Systick freq (kHz)
1	18	0.75
2	24	1
3	36	1.5
4	48	2
5	72	3

The ratio CPU_freq / SysTick = 24000 applies for all these values.



5.2.2 Periodic Systick interrupt

The periodic Systick makes a call to the CircleOS Systick interrupt handler which performs a short process on each of the STM32-EvoPrimer components: LEDs, button, buzzer, LCD and so on.

Note that the MEMS handler is called from the Timer2 interrupt, which has a priority higher than the Systick interrupt. This ensures a fixed and precise measurement rate.

I2S transfers towards the audio Codec chip are handled through the DMA interrupt.

5.2.3 Application scheduler

CircleOS is the base application of the EvoPrimer. It handles the menu selections and reacts to user actions. When an application is run (usually through a menu selection), CircleOS calls an initialization routine for the application, CircleOS then repeatedly calls the application handler at the Systick frequency until it returns a `MENU_LEAVE` value.

You will find more details about programming CircleOS applications in Chapter 6 “Developing CircleOS applications”.

5.2.4 Periodic Timer2 interrupt

The SPIs used to control the MEMS are both driven from the Timer2 interrupt handler which is triggered at a fixed rate:

Level	CPU freq (MHz)	Systick freq (kHz)	Timer2 freq (Hz)
1	18	0.75	136.5
2	24	1	182
3	36	1.5	273
4	48	2	364
5	72	3	546

The Timer2 priority is **higher** than the Systick priority. It is mandatory to keep this IRQ at the highest level in order to guarantee proper MEMS behavior.

Note: The frequency of the Timer2 overflow has been set to read a maximum number of measurements from the MEMS. However, this high rate is often useless, and you could easily change this frequency to save CPU time, or to get some more stable data from the MEMS.

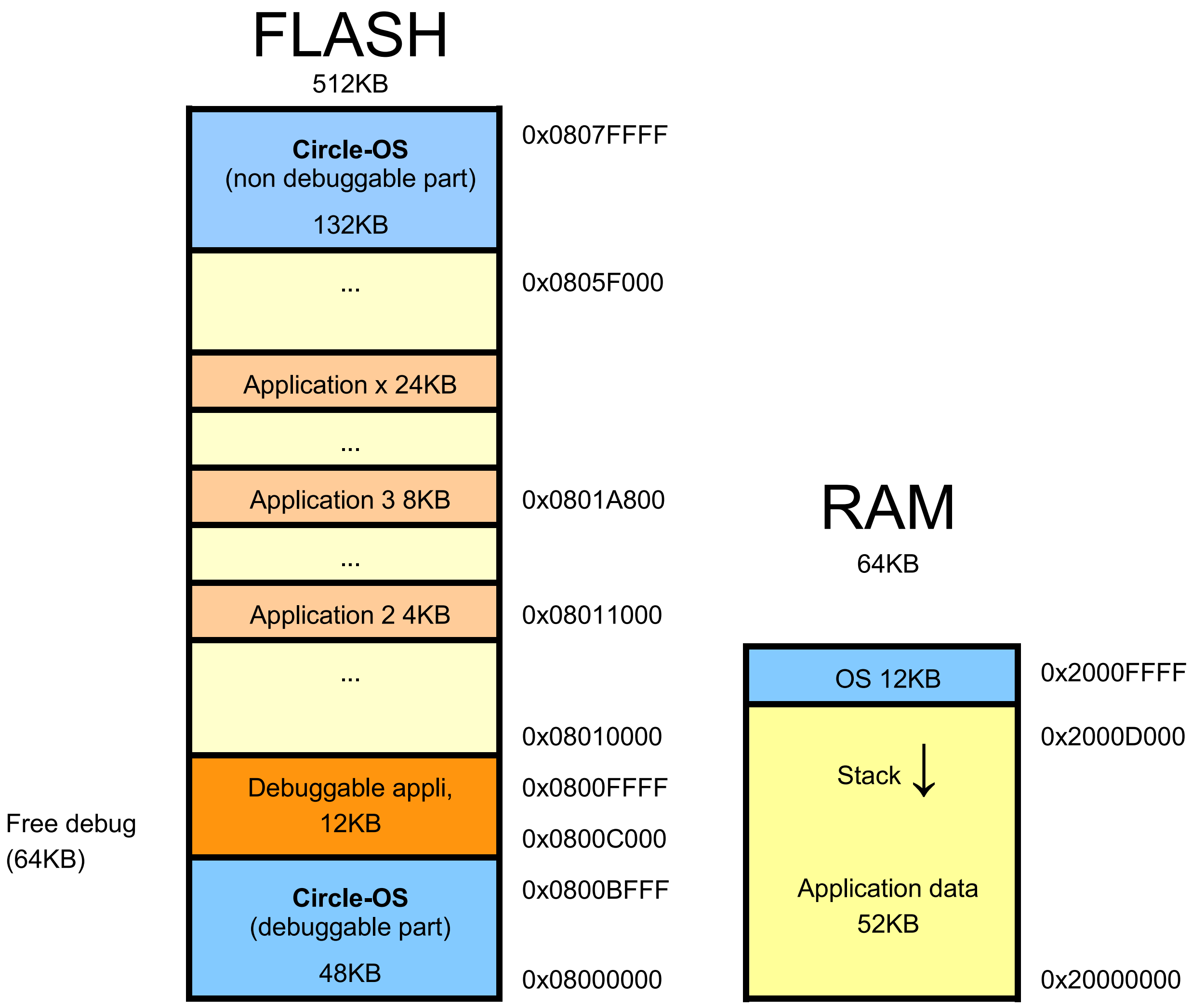
5.3 CircleOS resource usage

5.3.1 Memory usage

The CircleOS firmware requires 48KB of debug code in Flash, 200KB of constants and non-debuggable code in Flash and 12KB of RAM (including the stack usage for the applications). The remaining 264KB of Flash (512 – 248) are available for applications, which can be added or removed at will using a programming tool (see below).

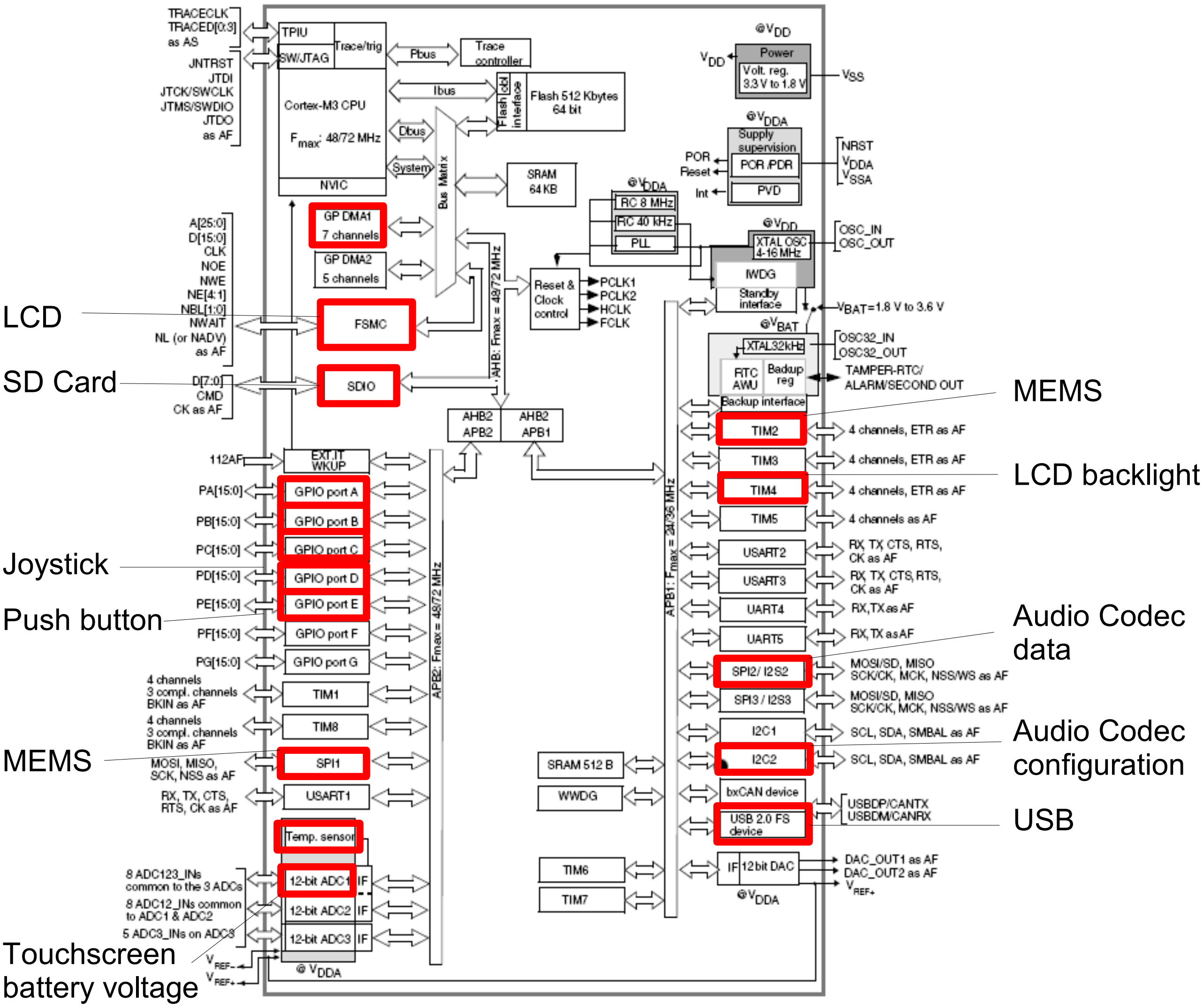
Flash memory can be programmed in 2KB blocks only.

The following shows an example of memory mapping:



5.3.2 Resources used by CircleOS

The following figure (from the ST datasheet) shows the peripherals used by CircleOS:



LCD

SD Card

Joystick

Push button

MEMS

Touchscreen battery voltage

MEMS

LCD backlight

Audio Codec data

Audio Codec configuration

USB

Illustration 5.1: STM32F103 peripherals

5.4 Managing applications on your EvoPrimer

The applications can be managed by the **circle_mgr.exe** utility, which is in the directory [RIDE7_INSTALL_DIR]\Bin. This utility can:

- List the currently loaded CircleOS applications.
- Add new CircleOS applications.
- Remove CircleOS applications.
- Check how much FLASH memory is available.

Refer to the http://www.stm32circle.com/ web site for more information about this utility.

The following commands are available with the **circle_mgr.exe** utility:

Command	Syntax	Description

List	L	List the loaded applications.
		The following information will be output:
		circle_mgr.exe L
		`Reading FAT table...`
		`App0: Name=Maze, Addr=0x08006000, Size=8KB`
		`App1: Name=Breakout, Addr=0x08008000, Size=4KB`
		`Largest free block= 92KB`

Add	Afilename	Add a new application (object file).
		circle_mgr.exe Ac:\tmp\level.o
		`Linking file C:\tmp\level.o...`
		`Link of C:\tmp\level.o succeeded...`
		`Hex file generated...`
		`Blank-checking the FLASH area...OK`
		`Programming file _tmp_.ld.hex to flash...OK`
		`Registering application in FAT... OK`

Erase	E*
	Eappname
		`circle_mgr.exe EMaze` `/*remove only 'Maze'*/`
		`circle_mgr.exe E*     /*remove ALL apps */`

Wait	W	When a command list is launched through a batch file, the W command allows you to pause the execution and to check the intermediate results.
Start	S	Start CPU execution

Caution: Any hex file can be programmed to the Flash memory of your EvoPrimer using the **cortex_pgm.exe** utility. However, doing this will destroy your CircleOS firmware, and you will have to reinstall it if you wish to use it later (refer to chapter 5.7for details).

5.5 Selecting the current application

One application is considered to be the “current application”. The ID of the current application is saved in the backup memory. From the main menu, you can launch it directly.

To change the current application, select the “Application” command from the main menu. Then select the application you wish to specify it as the “current application” and push the button. The new “current application” name will now appear in the main menu.

5.6 Downloading new applications

On the http://www.stm32circle.com/projects Circle web site you will find a database where the members can share their applications with the stm32circle community.

An application can include both the source files and the object files, or just the object files.

An application is generally made of one object file, but may occasionally have several of them. The linking of the application in such a case can be done either using the **circle_mgr.exe** software (available in the “[RIDE7_INSTALL_DIR]\bin” directory) or within the Ride7 environment. When an application is split into several object files, these object files must be placed in a library in order to pass a unique filename as an argument to **circle_mgr.exe**.

5.7 Resetting your EvoPrimer

5.7.1 Hardware reset

A hardware reset will restart your EvoPrimer (restoring it to a clean state), but will not remove its ROM contents.

1. Remove any USB cable.
2. Remove the plastic case protecting the target board.
3. Change the switch to its open state (this disconnects the internal battery) then replace the switch as it was.
4. Put the plastic case back in place.
5. Restart your EvoPrimer by pressing its button.

5.7.2 Software reset - CircleOS

This software reset erases all the Flash memory in your EvoPrimer and all applications. The CircleOS is replaced. This operation takes approximately 30 seconds:

1. Connect your EvoPrimer's debug USB port to your PC.
2. Power-up your EvoPrimer by pressing its button.
3. Open a command prompt from Windows (Start | Programs | Accessories | Command prompt).
4. Reload the initial program, using the command:
   `Update_EvoPrimer_STM32E_Circle_OS.bat` from Ride7 or
   `Program_Evo_STM32E_CircleOS_only` from stm32circle website in the upgrade zip file.

Note: This operation can also be done with the following command:

```
Cortex_pgm TSTM32F103VET6 E PEvo_Circle_STM32C.hex S
```

where `TSTM32F107VCT6` selects the appropriate device
`E` erases the ROM.
`Evo_Circle_STM32E.hex` is the full application available on the web site.
`S` restarts the device.

5.7.3 Software reset - Factory configuration

If you have been experimenting with CircleOS applications and have modified your EvoPrimer configuration, you may want to restore the initial (factory) configuration. This operation takes approximately 30 seconds:

1. Connect your EvoPrimer's debug USB port to your PC.
2. Power-up your EvoPrimer by pressing its button.
3. Open a command prompt from Windows (Start | Programs | Accessories | Command prompt).
4. Launch the command **`Restore_EvoPrimer_STM32E_Circle_Factory.bat`**
   If the command is not recognized, change the current directory to the Ride7 installation directory. This can be done with the following command (adapt it to your actual configuration if you did not install Ride7 in its default location):
   ```
   cd "C:\program files\Raisonance\Ride\lib\ARM\CircleOS"
   ```
5. The batch script erases your EvoPrimer, reprograms it with its factory ROM image which is in the circle hex file, then restarts the device.

Note: This operation can also be done with the following command:

```
Cortex_pgm TSTM32F103VET6 E PEvo_STM32E_Circle_Factory.hex S
```

where `PEvo_STM32E_Circle_Factory.hex` programs the device with the proper hex file.

6. Developing CircleOS applications

The full source files of CircleOS are available on the http://www.stm32circle.com/ web site.

Once registered, you will be able to download them, along with many resources for developing your application. The games originally delivered with the EvoPrimer show working application examples.

6.1 Developing your first CircleOS application

Creation of a CircleOS application is done automatically in Ride7:

1. Navigate to **Project | New project**.
2. Set the **Type** selection list to **New application**.
3. In the **Processor** selection list, select the **STM32E_Evo_CircleOS** device.
4. Select an application name such as **My CircleOS application**.
5. Define the location where your new project will be created.
6. Click the **Finish** button.
   Your new project will be created, with an application containing a CircleOS application skeleton as well as the **Evo_Circle_STM32E.elf** and **FAT_OP4.elf** files necessary to connect your application to CircleOS.
7. Open the *Application.c* file.
8. Search for the `Application_Name` variable in the file.
9. Change the `Application_Name` value from `My App` to `HELLO`.
10. In the `Application_Handler` function, create a new string as follows:
    `const char msg[] = "Hello, World!";`
11. Use the `DRAW_DisplayString CircleOS` service to display the `msg` string variable you just created:
    `DRAW_DisplayString( 5, 20, msg, sizeof(msg)); // X, Y, string, length`
12. Build your project using the **Project | Make Project** command.
13. Connect your EvoPrimer to your PC using the USB cable (using the Prrimers debug USB port).
14. From Ride7, go to **Debug | Start**, this programs your application to your EvoPrimer. This may take about 15 seconds.
15. Go to **Debug | Run**.
16. On your EvoPrimer, select your application name on the main menu.

Your application is now on your EvoPrimer.

For further information about CircleOS application programming and available OS services, please visit *http://www.stm32circle.com/*.

6.2 Libraries

Some common services are offered to ease your development of CircleOS applications.

1. The STM32 libraries, written by ST, provide access to the embedded peripherals (such as timers, ADC, communication interfaces, thermometer, etc...) of the STM32 microcontroller.
2. The low-level CircleOS functions that provide an easy access to the EvoPrimer's on-board peripherals: 3D accelerometer, LCD monitor, button, buzzer, battery, LEDs.
3. The graphical functions that provide powerful high-level functionality: Menu management, pointers (linked to the 3D accelerometer), character maps, sound.

The source files of these libraries can be found on:

- ST web site for the STM32 libraries (includes other documentation about the STM32 library)
- On the http://www.stm32circle.com/ web site for the CircleOS libraries (registration required).

Library documentation is accessible from Ride7.

6.3 Debugging your application

In order to debug your application:

1. Go to **Project | Properties** in Ride7.
2. In the **Configuration** selection box, select the **Circle_Debug** configuration (which is the default).

Ride7 takes care of all the settings required to switch between debug and release mode through the use of these configurations.

Note: The standard STM32F EvoPrimer is limited to debugging in the first 64KB only. A software key can be purchased on *http://www.stm32circle.com/* to allow debugging in the whole 512KB of memory.

6.4 Sharing your application with the Circle community

Once your application works properly, you can share it with the other members through the *http://www.stm32circle.com/* community.

7. Conformity and recycling

For more information on conformity and recycling, please visit the Raisonance website *www.raisonance.com*

ROHS Compliance (Restriction of Hazardous Substances)

Raisonance products are certified to comply with the European Union RoHS Directive (2002/95/EC) which restricts the use of six hazardous chemicals in its products for the protection of human health and the environment.

The restricted substances are as follows: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE).

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As part of our continuing efforts to proved the best service to our users an communities, Raisonance is actively defining take-back and recycling programs for EU customers as part of the implementation of the European WEEE directive. The WEEE symbol is a reminder not to dispose of your electronic equipment in standard trash receptacles.

For more information about disposal and recycling of electronic goods, please refer to http://www.raisonance.com/support/weee.php.
Raisonance disposes of its electrical equipment according to the WEEE Directive (2002/96/EC).

Upon request, Raisonance can recycle customer’s redundant products.

8. Glossary

Term	Description
STM32F EvoPrimer	EvoPrimer for STM32F103VE MCU, a microcontroller evaluation & development platform
EvoPrimer	Commercial products which are derived from the Raisonance Open4 and distributed by STMicroelectronics for exploring, evaluating, developing and fine tuning applications for a variety of ST 8 and 32-bit microcontrollers. Certain use limitations may apply to these commercial products
Open4	Raisonance versatile hardware platform, which is used in a variety of commercial products that allow users to explore, evaluate, develop and fine tune applications for a range of microcontrollers that are mounted on Open4 compatible target boards. Also refered to as the "base platform." Also distributed under the name EvoPrimer base
Target board	Boards featuring target microcontrollers which, when installed on an Open4-derived base allow execution of applications, programming of the target microcontroller and debugging of the applications running on the target microcontroller. Hardware features of target boards will vary depending on the target MCU and its features. Some features of the base platform may not be available depending on the features and capabilities of the target microcontroller
Extension board	Application-specific extension board, connected to the extension connector.
CircleOS	Embedded OS running on the Primer development kits.

9. Index

Alphabetical Index

10. History

Date	Modification
13 July 2010	Initial version.
09 Sept 2010	Memory maps update (CircleOS v4.1)
19 March 2012	Added STM32G-DB information.

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This manual exists both in paper and electronic form (pdf).

Please check the printed version against the .pdf installed on the computer in the installation directory, for the most up-to-date version.

The examples of code used in this document are for illustration purposes only and accuracy is not guaranteed. Please check the code before use.