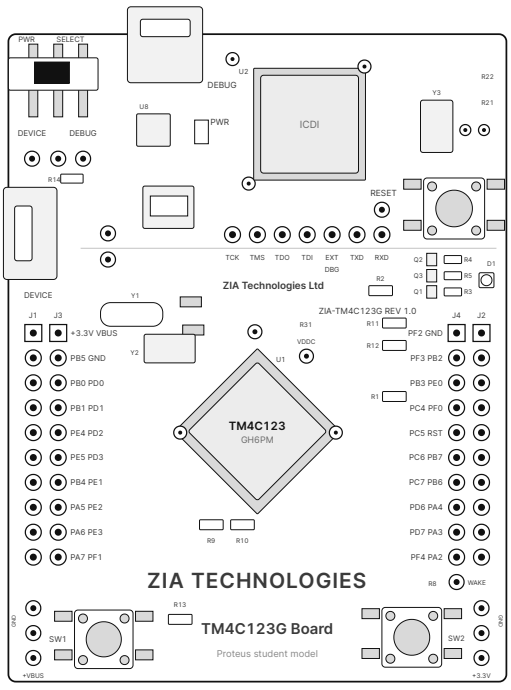
ZIA TM4C123G Board Simulator

Run your Keil uVision 5 programs on the TM4C123G LaunchPad without the board: live RGB LED, clickable buttons and a UART terminal in your browser.



Version
1.0 Preliminary

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ZIA-DOC-TM4C-002

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Title	ZIA TM4C123G Board Simulator User Manual
Document	ZIA-DOC-TM4C-002
Version	Simulator 1.0, preliminary, November 2026
Applies to	Keil MDK 5 (uVision 5) on Windows 10 and 11
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Contact	info@ziafoundry.com
See also	ZIA TM4C123G Board for Proteus, ZIA-DOC-TM4C-001

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1

Introduction

The ZIA TM4C123G Board Simulator runs the programs you write in Keil uVision 5 on a model of the TM4C123G LaunchPad, without the real board. You build as usual, click **Tools › Run on ZIA Board**, and the board opens in your web browser with your program running on it.

The RGB LED glows in the colour and brightness your program drives. You press SW1, SW2 and RESET with the mouse, read and type UART0 text in a terminal, and see the level of every header pin. When the program does something that would fail on the real board, for example using a port before turning its clock on, the simulator says so in plain words.

It is made for students who want to try their lab code at home, and for instructors who want to show a program running in class. It does not replace the board in the lab: it is a way to find most mistakes before you get there.

How it works

	What happens
1	Keil builds your program into an `.axf` file, the same file it loads onto the real board.
2	**Run on ZIA Board** in the Keil Tools menu hands that file to the simulator.
3	The simulator checks the licence of the computer, then runs the program on a model of the TM4C123GH6PM chip and of the parts on the board, in real time.
4	The ZIA Board Viewer shows the board in the browser and passes your clicks and typing back to the program.

Licence

The simulator is licensed to universities and companies. If your university has a ZIA licence, you sign in with your university email and the simulator runs on your PC (section 4).

2

Quick start

For readers who know Keil already. Each step is explained with screenshots in sections 3 to 6.

1. Download the setup program from **ziafoundry.com/products/tm4c123g-board-simulator** and run it.
2. Click through the pages. Setup adds **Run on ZIA Board** to the Keil Tools menu by itself.
3. When setup shows a code, your browser opens the ZIA Foundry Portal. Check the code and sign in with your university or company email.
4. Open your project in Keil and build it with F7.
5. Click **Tools › Run on ZIA Board**. The board opens in the browser with your program running.

Tip

To see the board before you write any code, open Start menu › **ZIA TM4C123G Board Simulator** › **ZIA Board demo**. If the RGB LED changes colour, everything is set up.

3 Installation

3.1 What you need

Item	Notes
Windows 10 or 11, 64-bit	Setup installs for your Windows account only. No administrator rights are needed.
Keil MDK 5 (uVision 5)	With Arm Compiler 6, as used in the lab. The free MDK-Lite edition is enough.
An account with a ZIA licence	Your university or company email, on a domain that has a ZIA licence. Ask your instructor if you are not sure.
Internet	To sign in once, and to renew the licence at least once every 7 days. The board itself runs offline.
A web browser	Chrome, Edge or Firefox. The board opens at `http://127.0.0.1:8765`, on your own PC only.
24 MB of disk space	Python and other tools are not needed: everything comes with the setup.

Board The real LaunchPad and its USB driver are not needed. Keil's own debugger is not used either.

3.2 Download

Download the setup program from the product page, **ziafoundry.com/products/tm4c123g-board-simulator**. Once you are signed in, the ZIA Foundry Portal (**portal.ziafoundry.com**) also has the download. The file is called `ZIA-TM4C123G-Board-Simulator-Setup-1.0.0.exe`, with the version number of the release.

Safety Download the setup only from ziafoundry.com. The publisher is ZIA TECHNOLOGIES LTD.

3.3 Run the setup

1. Close Keil uVision if it is open. Setup still works with Keil open, but the new menu entry only shows after Keil starts again.
2. Run the setup program. The first page says what it will do. Click **Start**.

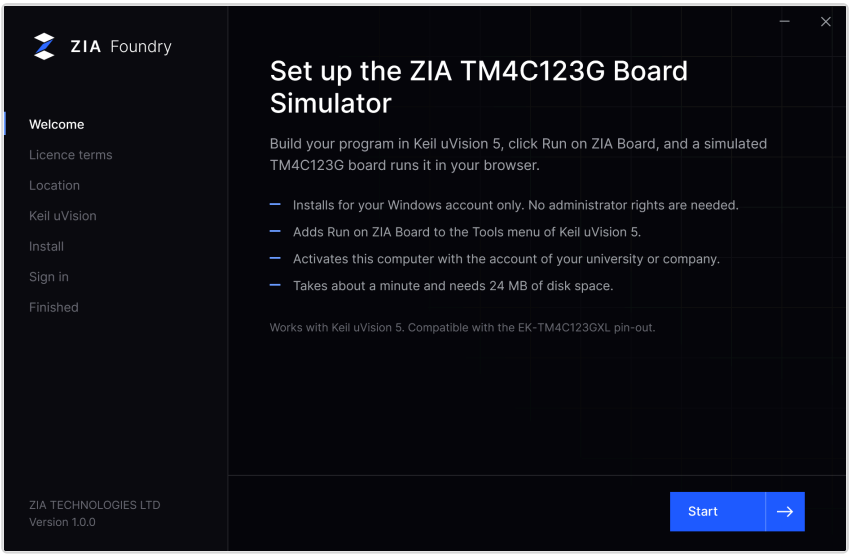


Figure 1 The first page of the setup.

3 Read the licence terms, tick that you accept them and click **Continue**.

4 Keep the suggested folder, or click **Change** to choose another one. Click **Continue**.

5 Setup looks for Keil uVision 5 and shows where it found it. Keep **Add Run on ZIA Board to the Keil Tools menu** ticked and click **Install**.

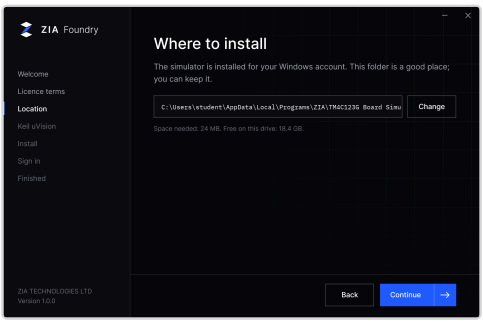


Figure 2 The install folder. The suggested one is inside your own Windows account.

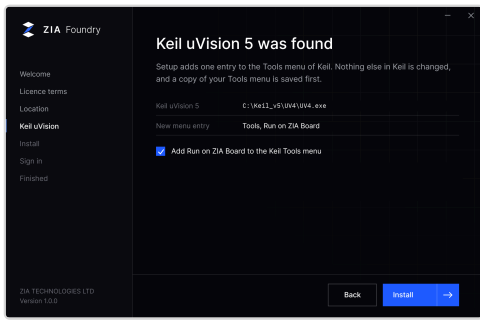


Figure 3 Keil was found. Setup adds one entry to its Tools menu and keeps a copy of the menu first.

No Keil

If Keil is not installed yet, setup says so and goes on. Add the entry later from the licence window (section 5.1).

3.4 Activate this computer

After the files are copied, setup activates the computer. This is where the licence of your university or company reaches your PC.

1 Setup shows a code of eight letters and opens the ZIA Foundry Portal in your browser.

2 Check that the page in the browser shows the same code. Only then sign in, with the email of your university or company.

3 Click **Activate this computer** on the page. Setup notices it within a few seconds and shows the licence.

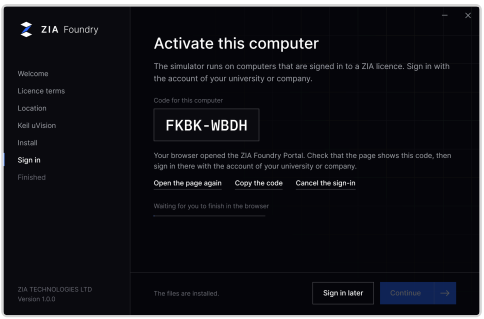


Figure 4 The code for this computer. The same code must show in the browser.

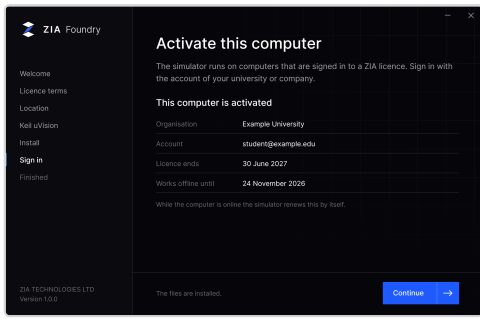


Figure 5 The computer is activated: the organisation, your account and how long it works offline.

Password You type your password only on the portal page in the browser. Setup never sees it.

Later Click **Sign in later** to finish without activating. The board then asks you to sign in the first time it starts.

4 On the last page, keep **Open the board demo now** ticked and click **Finish**. The board opens in the browser.

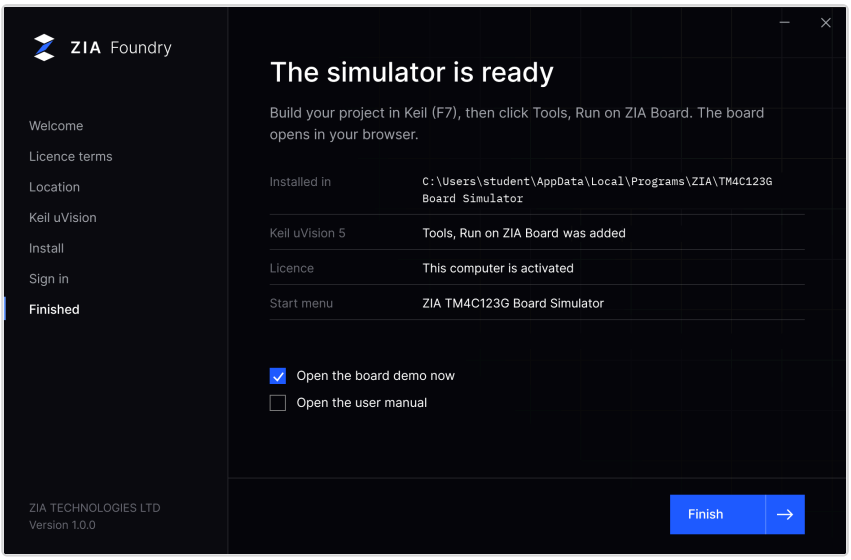


Figure 6 Setup is finished. The page sums up the folder, the Keil entry, the licence and the Start menu folder.

3.5 What setup put on the PC

What	Where
The simulator	`%LOCALAPPDATA%\Programs\ZIA\TM4C123G Board Simulator`, unless you chose another folder
Keil Tools menu	**Run on ZIA Board**, which runs `ZiaBoard.exe "#L"` from that folder
Start menu	**ZIA TM4C123G Board Simulator**: *ZIA Board demo*, *ZIA Board user manual*, *ZIA Board Keil example project*, *ZIA Board licence and sign in*, *Uninstall ZIA Board Simulator*
Installed apps	An entry in Windows Settings › Apps, used to remove the simulator (section 11)

What	Where
Licence	A licence file in your Windows account (`%LOCALAPPDATA%\ZIA`), protected by Windows for your account only

4 Licence and sign in

4.1 How the licence works

Rule	In practice
The licence belongs to your organisation	Your university or company holds a ZIA licence for its email domain. Anyone who signs in with an email on that domain is covered, with no key to type.
2 computers per account	One account can activate the simulator on two computers, for example a laptop and a home PC. To use a third, sign out on one of the two first (section 4.2), or remove it on the portal (section 4.3).
7 days offline	The computer keeps a licence that works without internet for 7 days. While it is online, the simulator renews it by itself.
The end date of the licence	The board stops when your organisation's licence ends, until it is renewed. The simulator tells you 14 days before.

4.2 The licence window

Open Start menu › **ZIA TM4C123G Board Simulator** › **ZIA Board licence and sign in**. The window shows the licence of this computer and has the buttons to sign in, to sign this computer out, to add or remove the Keil menu entry and to check for updates.

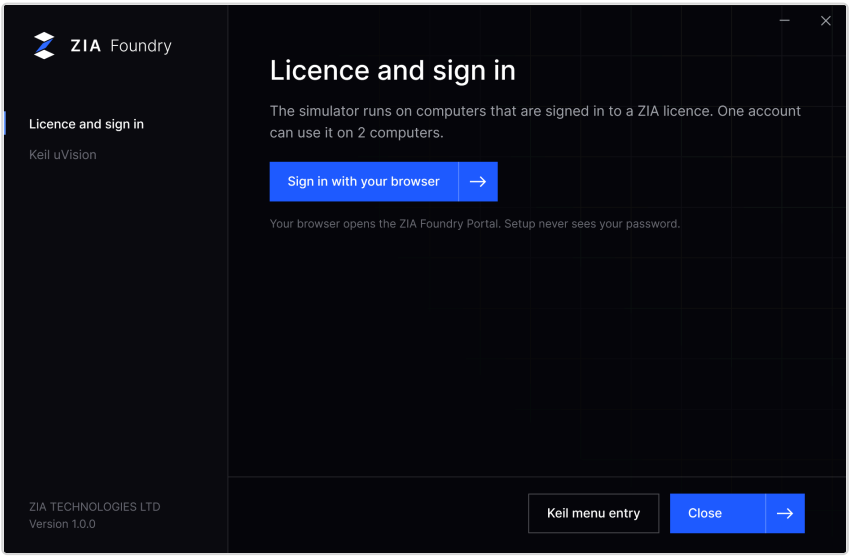


Figure 7 The licence window of a computer that is not signed in yet.

Move

Changing computers: click **Sign out of this computer** on the old one first. Its place in your licence then becomes free for the new one.

4.3 The ZIA Foundry Portal

The ZIA Foundry Portal at **portal.ziafoundry.com** is where accounts and licences live. You sign in with your email and a password; the first time, the portal sends an 8-digit code to your email to check it is yours.

Who	What the portal shows
Students and staff	Your licence, the computers signed in with your account, and the download of the setup program. You can remove a computer you no longer use, for example one you sold or lost.
Administrators of an organisation	The members, licence seats and computers of the organisation. They can remove a member or sign out a lost computer.

5 Keil uVision 5

5.1 The Run on ZIA Board entry

Setup adds **Run on ZIA Board** at the end of the Keil **Tools** menu. The entry is kept by Keil and works for every project.

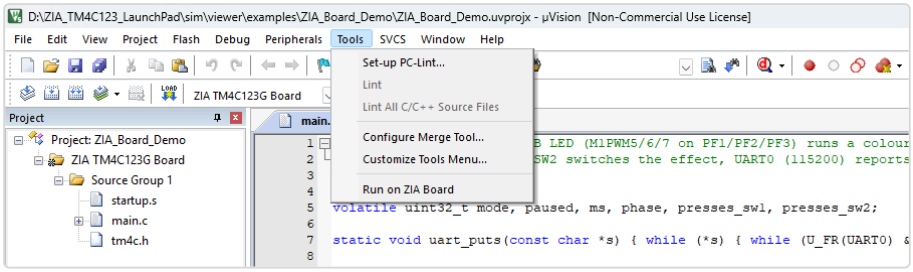


Figure 8 The Keil Tools menu with the new entry.

If the entry is missing, for example because Keil was installed after the simulator, open the licence window (section 4.2), click **Keil menu entry** and then **Add the entry**. Restart Keil to see it.

By hand

The entry can also be made in Keil with **Tools › Customize Tools Menu**: Command is `ZiaBoard.exe` in the install folder, Arguments is `"#L"` with the quotes. Keil replaces `#L` with the full path of the program it built.

5.2 Open the example project

Open Start menu › **ZIA TM4C123G Board Simulator** › **ZIA Board Keil example project**. It puts a copy of the project in `Documents\ZIA Board Demo` and opens it in Keil. Press F7: the Build Output must end with *0 Error(s), 0 Warning(s)*.

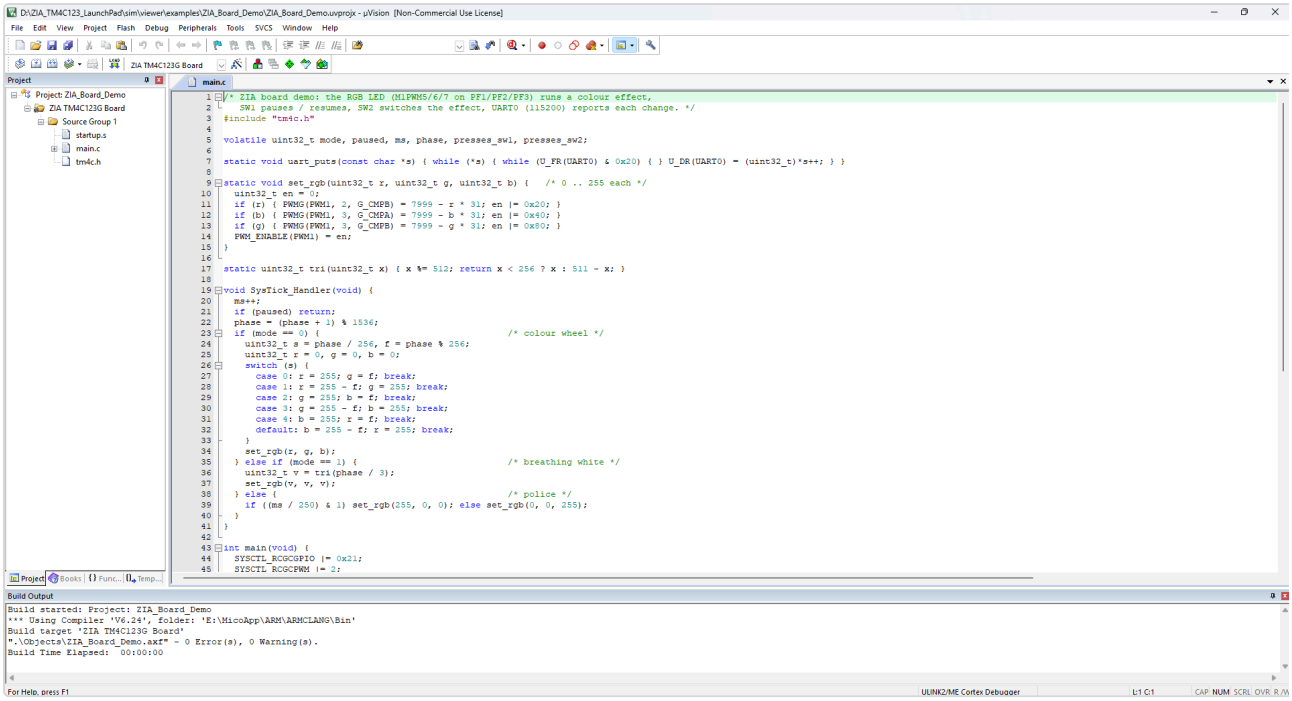


Figure 9 The example project in Keil uVision 5 after a build. The program is in `Objects\ZIA_Board_Demo.axf`.

5.3 Your own projects

Lab projects work as they are. The simulator only needs the `.axf` file that Keil makes anyway.

Setting in Options for Target	Value
Device	TM4C123GH6PM, or the generic ARMCM4 used in the lab manual
Output › Create Executable	Ticked (the default). This makes the `.axf` file.
Target › Floating Point Hardware	Single Precision or Not Used: both run
Code	Assembly or C, with or without TivaWare headers. TivaWare `ROM_` calls are not simulated (section 9).

6 Running a program

6.1 Build and run

1. Write or change your code and press F7. Check that the Build Output says *0 Error(s)*.
2. Click **Tools › Run on ZIA Board**.
3. A small black window called **ZIA Board Viewer** opens. It checks the licence, then shows the address of the board and the program it runs. Keep it open while you work: it is the simulator, and closing it stops the board.
4. The board opens in your web browser. If it does not, open `http://127.0.0.1:8765` yourself.

6.2 The ZIA Board Viewer

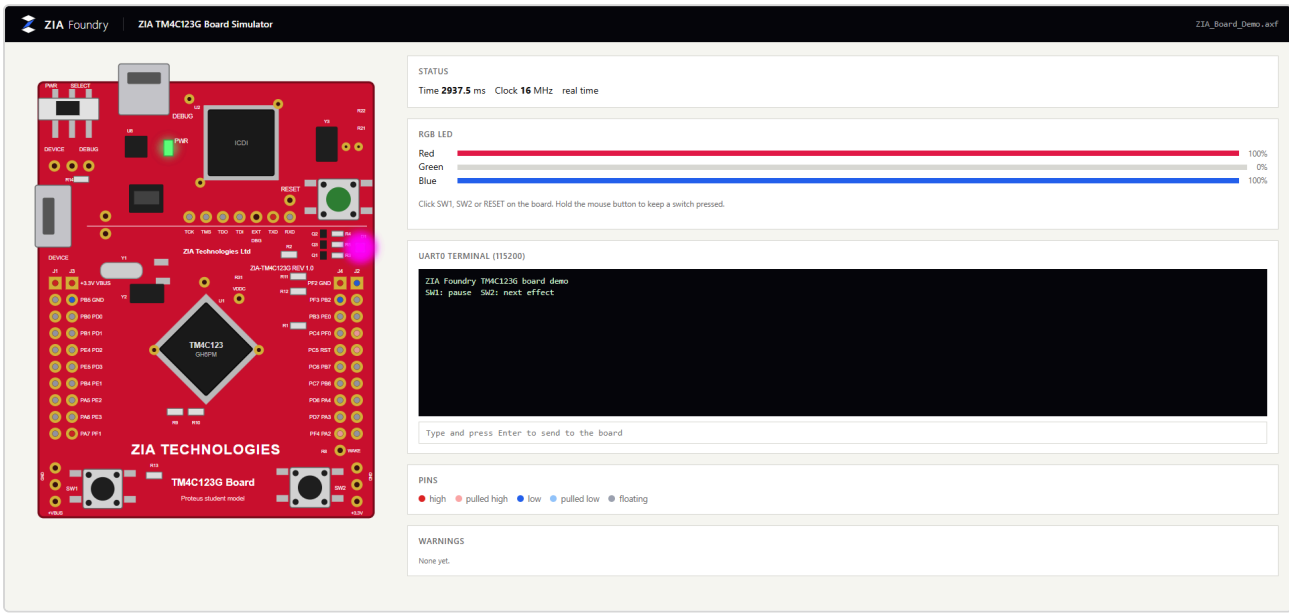


Figure 10 The ZIA Board Viewer running the example program. The RGB LED mixes red and blue, so it shows magenta.

Part of the page	What it shows
Board	The ZIA board drawn like the real LaunchPad. The RGB LED glows, the header pins are coloured by their level, and SW1, SW2 and RESET can be clicked.
Status	Board time since reset, the system clock (16 MHz after reset, up to 80 MHz with the PLL) and whether it runs in real time.
RGB LED	Brightness of red, green and blue, 0 to 100 %. PWM dimming shows as a part value.
UART0 terminal	Text the program sends on UART0 at the baud rate it set, as the LaunchPad's virtual COM port would show it.
Pins	Key to the pin colours: high, pulled high, low, pulled low, floating.

Part of the page	What it shows
Warnings	Mistakes found while the program runs, in plain words (section 10).

6.3 Buttons, LED and terminal

- **SW1 and SW2**: click the button on the board. Hold the mouse button down to keep it pressed, as with the real switch. The pin reads 0 while it is pressed, so the program must turn on the pull-up resistor.
- **RESET**: click it to restart the program from the beginning, as the reset button does on the board.
- **Terminal**: type in the box under the terminal and press `Enter` to send the text to the board on UART0.

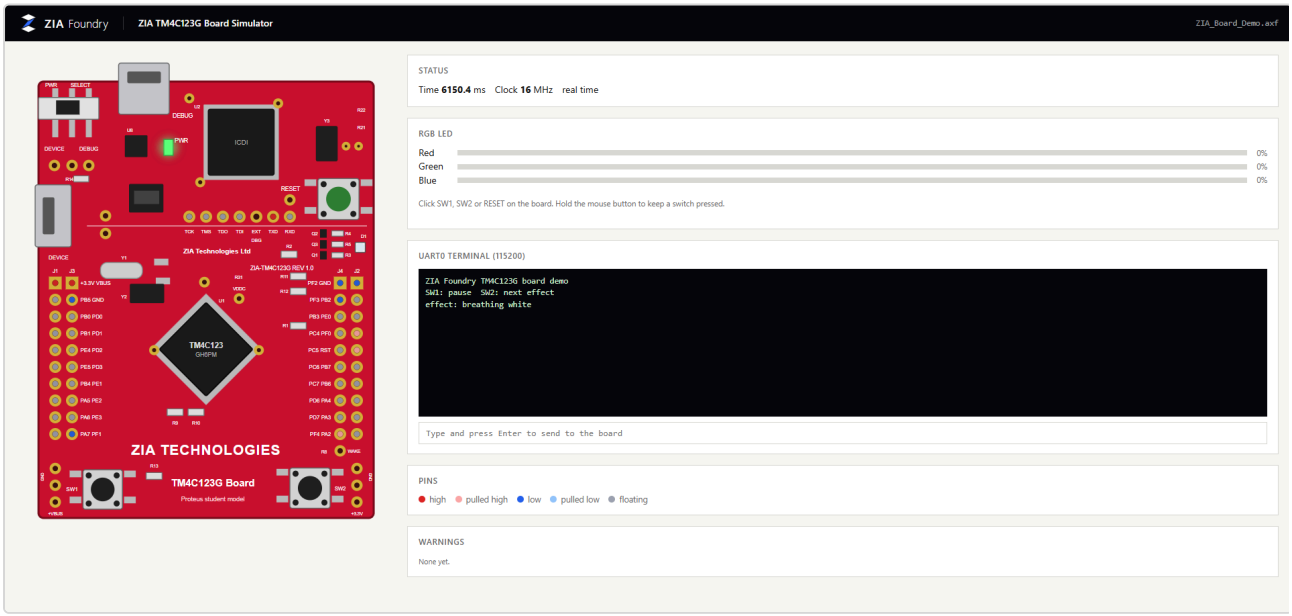


Figure 11 After pressing SW2 the example program switches to the white breathing effect and reports it on UART0.

6.4 Changing the program

Change the code, press `F7` and click **Run on ZIA Board** again. The board that was running closes by itself and the new program starts from reset. Reload the browser page if it still shows the old one. To stop, close the **ZIA Board Viewer** window.

7

Updates

Once a day, when the board starts, the simulator asks the ZIA Foundry Portal whether a newer version exists. It never waits more than a few seconds for the answer, and without internet it simply runs.

Kind of update	What happens
Optional	The ZIA Board Viewer window says a new version is available, and the update window opens once for each new version. Update now or later.
Required	The board does not start until the new version is installed. The update window opens by itself.

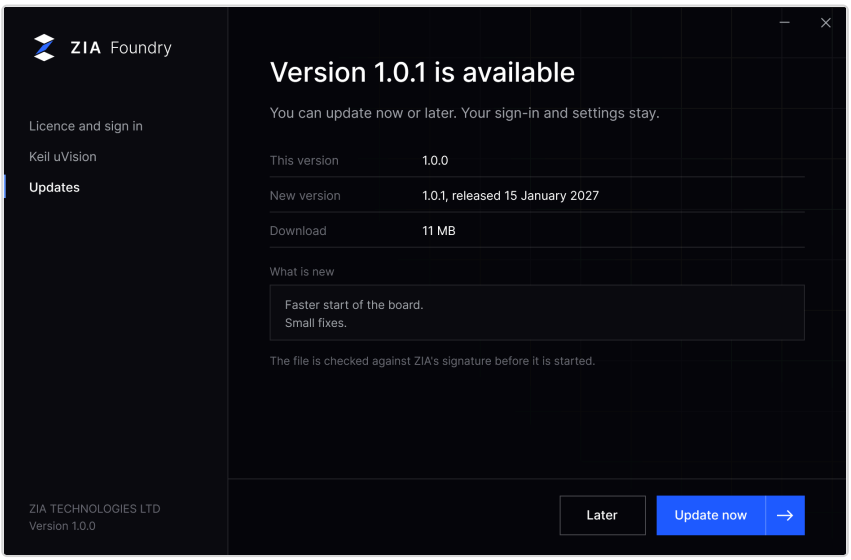


Figure 12 The update window: what is new, and Update now.

To check yourself, open the licence window (section 4.2) and click **Check for updates**. Updating keeps your sign-in, the Keil entry and your settings. Every download is checked against the signature of ZIA Foundry before it is started, and setup never replaces a newer version with an older one.

8

Command line simulator

The same simulator runs without the browser. This is useful to check a program quickly, or to see exactly when each pin changed. Open a Command Prompt in the `bin` folder of the install folder:

```
zia_sim.exe "C:\Labs\lab1\Objects\lab1.axf" --ms 1000 --events
```

It runs one second of board time and prints the UART0 text, the RGB LED state, the pin changes with their times and the warnings.

Option	What it does
`--ms 1000`	Board time to run, in milliseconds.
`--press SW1:200:400`	Hold SW1 from 200 ms to 400 ms. Also `SW2` and `RESET`; repeat the option for more presses.
`--analog PE3=1.65`	Voltage on an analog input, by pin or by name (`AIN0=1.65`).
`--temp 25`	Chip temperature in °C for the internal temperature sensor.
`--i2c 0:24C02:0x50`	Put a 24C02 EEPROM on I²C0 at address 0×50. `LM75` adds a temperature sensor.
`--spi 2:ram:PB5`	Put an SPI RAM on SSI2 with its chip select on PB5. `wire` joins MOSI to MISO.
`--events`	Print every pin change with its time.
`--regs`	Print the CPU registers at the end.

9

What is simulated

Part of the chip	Simulated
CPU	Cortex-M4F instruction set with the floating point unit, NVIC with priorities and nesting, SysTick, faults.
Clock	Main oscillator, PLL up to 80 MHz, sleep with `WFI`.
GPIO	Ports A to F, pull-up and pull-down, open drain, interrupts, the PF0 lock, the R9 and R10 links.
Board	RGB LED, SW1, SW2 and RESET.
UART	UART0 to UART7 with FIFOs, interrupts and loopback. UART0 appears in the terminal.
Timers	TIMER0 to TIMER5 and WTIMER0 to WTIMER5: periodic, one-shot, PWM, edge count and edge time capture.
ADC	ADC0 and ADC1, all sequencers, AIN0 to AIN11, temperature sensor, averaging, timer and PWM triggers.
PWM	PWM0 and PWM1 modules, count-down and up/down, deadband, interrupts and ADC triggers.
I²C and SSI	I²C0 to I²C3 and SSI0 to SSI3 in master mode, bit by bit on the pins, with the parts in section 8.

Not simulated yet

CAN, USB, QEI, watchdog, hibernation, EEPROM, uDMA, timer RTC mode, I²C and SSI slave mode, PWM fault inputs, ADC comparators and the TivaWare `ROM_` functions. Programs that use them still run, but those registers read as 0 and a warning tells you which part was used.

Accuracy

The simulator is checked against the student lab programs, an independent emulator, programs built with the Keil compiler and the data sheet reset values. It has not yet been compared with the real board side by side, so check timing-critical work on the board.

10

Troubleshooting

Problem	What to do
The window says this computer has no valid licence	Sign in: open the licence window (section 4.2) and click **Sign in with your browser**. Use the email of your university or company.
The portal says your email has no licence	Your organisation has no ZIA licence for that email domain yet, or its licence has ended. Ask your instructor or your IT department.
The portal says the account already uses 2 computers	Sign out on one of them (section 4.2), or remove a computer you no longer have on the portal (section 4.3).
The licence stopped working without internet	The offline licence lasts 7 days. Connect to the internet and start the board again; it renews by itself.
Run on ZIA Board is not in the Tools menu	Restart Keil. If it is still missing, add it from the licence window (section 5.1).
A window says *Program not found*	Build the project first with F7, and check that **Create Executable** is ticked in Options for Target › Output.
The browser does not open	Open `http://127.0.0.1:8765` yourself. The ZIA Board Viewer window shows the address.
The browser shows the old program	Reload the page. Each run replaces the previous one on the same address.
Port 8765 is in use by another program	Write `"viewer_port": 8790` in `settings.json` in the install folder, then open that address.
The LED never lights	Read the Warnings panel. Most often the port clock is not on, the pin is not set as output in `DIR`, or `DEN` is not set.
SW1 or SW2 does nothing	Turn on the pull-up in `GPIO_PORTF_PUR_R`. For SW2 also unlock PF0 first (`LOCK` and `CR`).
No text in the terminal	Set PA0 and PA1 to UART (`AFSEL`, `PCTL`, `DEN`) and turn on the UART0 and port A clocks.

Warnings

The simulator prints a warning instead of failing silently. Some examples:

Warning	What to fix
Port F was used before its clock was turned on (RCGCGPIO). On the real board this causes a HardFault.	Set the port's bit in `SYSCTL_RCGCGPIO_R` first.
The pin is an input with nothing connected and no pull-up or pull-down.	Turn on the pull-up for a button (`GPIO_PORTF_PUR_R`).
UART is sending but its pins are not set up (AFSEL, PCTL, DEN).	Set the alternate function of the TX and RX pins.
SDA is floating; an I²C bus needs pull-up resistors.	Add pull-ups, and set SDA to open drain.
A part of the chip that is not simulated yet was used.	The program still runs; its registers read as 0. See section 9.

11

Removing the simulator

Open Start menu › **ZIA TM4C123G Board Simulator** › **Uninstall ZIA Board Simulator**, or choose the simulator in Windows Settings › Apps › Installed apps and click **Uninstall**.

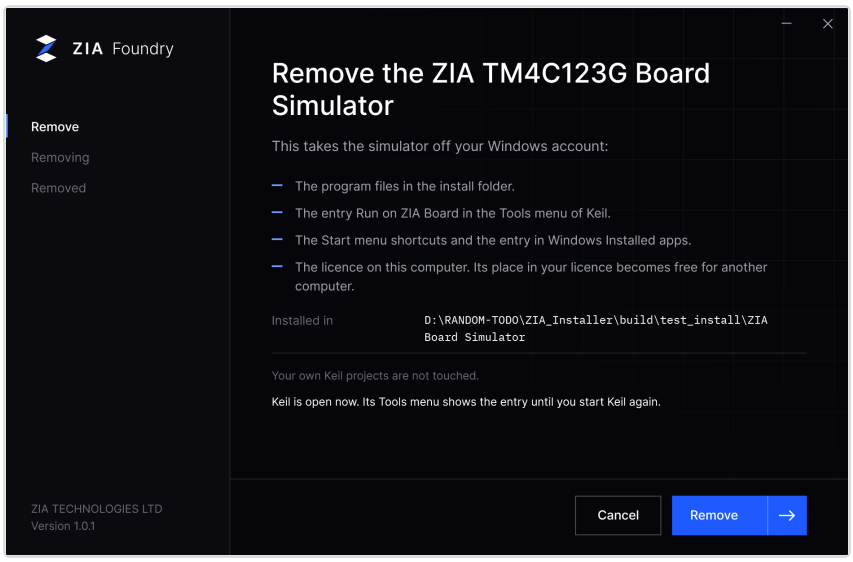


Figure 13 Removing the simulator.

Uninstalling signs this computer out, so its place in your licence becomes free for another computer. It removes the **Run on ZIA Board** entry from Keil and leaves the rest of the Tools menu as it was, then removes the files and the Start menu folder. Your copy of the example project in `Documents\ZIA Board Demo` stays: it is yours to keep or delete.

12

Specifications and support

Item	Value
Simulated chip	TM4C123GH6PM: Cortex-M4F, 256 KB flash, 32 KB SRAM
Simulated board	EK-TM4C123GXL LaunchPad layout: RGB LED on PF1, PF2, PF3; SW1 on PF4; SW2 on PF0; RESET; R9 and R10 links
Clock	16 MHz precision oscillator after reset; main oscillator and PLL up to 80 MHz
Speed	1.1 to 3.5 times faster than the real board at 16 MHz, depending on the program. The viewer slows it to real time.
Program files	`.axf` (ELF) from Keil uVision 5 with Arm Compiler 6
Viewer	Web page at `http://127.0.0.1:8765`, reachable from this PC only
Operating system	Windows 10 or 11, 64-bit
Licence	Per organisation, 2 computers per account, 7 days offline
Release	Simulator 1.0.0, manual November 2026

Support

Where	Address
Product page	ziafoundry.com/products/tm4c123g-board-simulator
Manuals	ziafoundry.com/documentation
Portal	portal.ziafoundry.com
Email	info@ziafoundry.com. Please write the version of the simulator (on the first line of the ZIA Board Viewer window) and what you see.

A

The example program

The example project (Start menu › *ZIA Board Keil example project*) is a small C program for the board. It uses SysTick, the PWM1 module on the RGB LED pins, both switches and UART0 at 115200 baud, so it shows most of the viewer at once. *ZIA Board demo* in the Start menu runs the same program without Keil.

Input	What the program does
Reset	Prints *ZIA Foundry TM4C123G board demo* on UART0 and starts the colour wheel.
SW2	Switches to the next effect: colour wheel, white breathing, then red and blue flashing. It prints the name of the effect.
SW1	Pauses the effect, and starts it again on the next press.

The files of the project:

File	Contents
`main.c`	The program.
`startup.s`	Vector table and reset handler for the TM4C123GH6PM.
`tm4c.h`	Register addresses used by the program.