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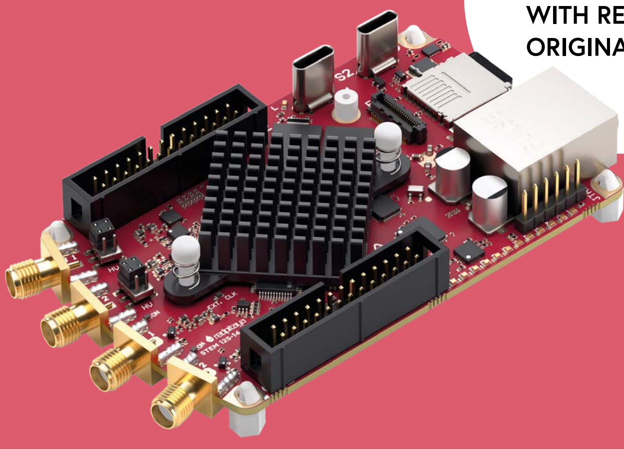
Experimenting with Red Pitaya STEMlab Gen 2

Practical Projects and Programs



redpitaya

COMPATIBLE WITH RED PITAYA ORIGINAL MODELS

Dogan Ibrahim

elektor MEDIA & LEARNING

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Practical Projects and Programs

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Red Pitaya: Open-Source Instrumentation for Research, Education and Industry

- Red Pitaya provides open-source, high-performance instrumentation platforms widely used in research, education, and industrial applications with more than 1,500 universities, 700 research institutes, and over 5,000 industrial labsworldwide employing its technology. Its platforms are trusted by institutions such as MIT, Stanford, CERN, and organizations including NASA and Apple, and have been used by more than 150,000 engineers, students, and researchers to accelerate experiments, prototype novel systems, and bridge laboratory precision with scalable applications.

- Red Pitaya has been recognized internationally for its impact on science and education. Most recently, in 2025, it received the Learning Technologies Award (Gold Winner), multiple distinctions at the Engineering Matters Awards— Gold Champion for Environment and Silver Champion for Innovation and Diversity & Inclusion — and was named a Design Team of the Year finalist at the Elektra Awards, receiving Highly Commended recognition for Educational Support.

- These recognitions reflect Red Pitaya’s commitment to democratizing access to advanced instrumentation and supporting the global research and education community.

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Elektor International Media B.V.
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British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN 978-3-89576-718-0 Print
ISBN 978-3-89576-719-7 eBook

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www.elektor.com
Prepress Production: D-Vision, Julian van den Berg
Printers: Ipskamp, Enschede, The Netherlands

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Preface

Test and measurement form the foundation of every scientific and engineering discipline. The ability to observe, quantify, and analyze signals is essential for both education and research. Traditionally, these tasks have been carried out with specialized laboratory instruments, each optimized for a narrow function. While indispensable, such instruments are often costly, inflexible, and beyond the reach of students, small laboratories, and individual innovators.

Red Pitaya is a credit card-sized, open-source test and measurement board that can be used to replace most measurement instruments used in electronics laboratories. With a single click the board can be transformed into a web-based oscilloscope, spectrum analyzer, signal generator, LCR meter, Bode plotter, and microcontroller. The Red Pitaya can replace the many pieces of expensive measurement instruments found at professional research organizations and teaching laboratories. Red Pitaya is a network attached device based on Linux. The device includes an FPGA, digital signal processing (DSP), dual core ARM Cortex processor, signal acquisition and generation circuitry, micro USB socket, microSD card slot, RJ45 socket for Ethernet connection, and USB socket.

By combining a powerful system-on-chip architecture with an open-source software environment, Red Pitaya offers a reconfigurable, compact, and cost-effective platform capable of emulating a wide range of measurement instruments. More importantly, it provides opportunities for experimentation and customization that conventional equipment cannot match.

Red Pitaya can be controlled using Matlab, LabView, Python, Scilib, and Visual Programming Language. Even the newcomers to the field of electronics and computing can start writing applications and programs using the visual programming language and they can create basic to intermediate level projects. Red Pitaya offers two analog inputs and two analog outputs, as well as digital I/O ports, making it suitable to interface to the external world of sensors, actuators, and displays.

This book is written for educators, researchers, and students seeking both a practical introduction and a detailed technical reference to Red Pitaya in the context of test and measurement. It provides an overview of the hardware and software architecture, explores measurement principles, and demonstrates how the platform can be adapted for various laboratory and research applications. Students can use the Red Pitaya to learn the practical applications of various electronic components, including resistors, capacitors, inductors, diodes, transistors, operational amplifiers, and so on.

The book utilizes the **Red Pitaya Gen 2,** which is the latest hardware version of Red Pitaya family. The Red Pitaya Gen 2 builds on the foundation of earlier Red Pitaya models while introducing significant enhancements in both hardware and performance. Compared to the first generation, Gen 2 offers a more powerful Xilinx Zynq Ultrascale+ MPSoC platform, increased memory, and improved data throughput, enabling faster signal processing and greater computational flexibility. The improved FPGA in Gen 2 transforms Red Pitaya from a primarily educational/prototyping platform into a professional-grade system capable of industrial control, advanced RF analysis, and real-time high-speed signal processing**.**

The upgraded analog front end of Red Pitaya Gen 2 provides higher sampling rates and improved ADC/DAC resolution, resulting in greater bandwidth and dynamic range for precision measurement and control. These improvements allow Gen 2 to move beyond the educational and prototyping space, positioning it as a high-performance platform suitable for advanced research, signal processing, and industrial deployment. Gen 2 provides higher bandwidth and dynamic range, making it suitable for more demanding measurement and control applications. While the earlier models established Red Pitaya as a versatile, affordable alternative to traditional lab instruments, Gen 2 elevates the platform to a professional-grade tool capable of addressing advanced research, industrial, and educational needs. Red Pitaya Gen 2 adopts USB-C connectivity, which marks a clear step forward compared to the micro-USB or standard USB ports on earlier models.

Large section of the book is devoted to the very important topic of using and programming the Red Pitaya FPGA. Example projects are given on using the FPGA with the help of the latest programming tools such as the **Vivado and Verilog.**

I hope that you will find the book useful and enjoyable and that it will help you while carrying out electronic experiments.

Dogan Ibrahim

Chapter 1 – What is Red Pitaya?

1.1 Overview

In this module you will learn what Red Pitaya is, its basic features, and where it can be used. The information given in this chapter will be useful before you learn to apply your electronics theoretical knowledge to practice.

This chapter covers the following topics:

- What Red Pitaya is and where it can be used
- What is in the box?
- Variants of the Red Pitaya
- Red Pitaya Gen 2 specifications
- Red Pitaya Gen 2 board layout

1.2 The Red Pitaya

There are many Test and Measurement (T&M) instruments in electrical and electronic engineering. These T&M instruments play very important roles in designing and testing of electrical and electronic devices, and they are heavily used in engineering laboratories. Figure 1.1 shows some of the frequently used T&M instruments found nearly in all electronic engineering laboratories and research centres. They are: digital multimeters (DMM), oscilloscopes, signal generators, spectrum analysers, logic analysers, frequency analysers, frequency counters, LCR meters, bode plotters, and so on.

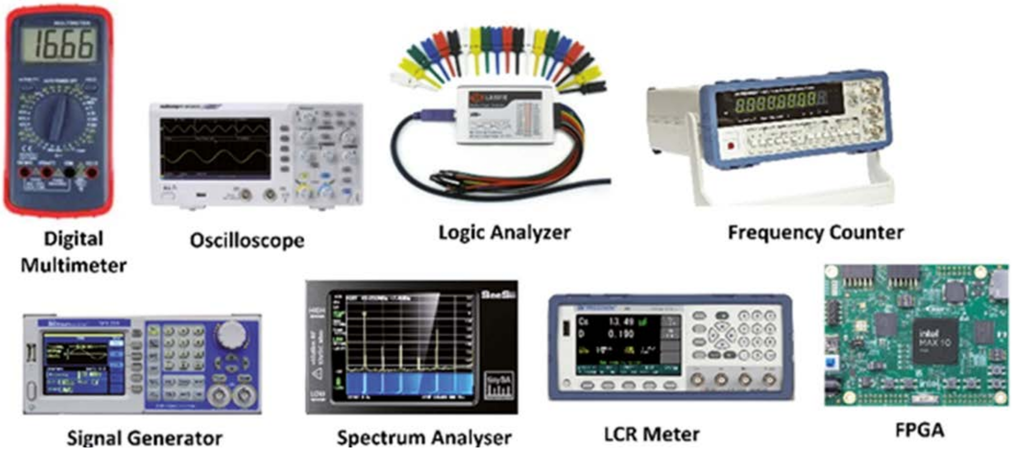

Figure 1.1 Some commonly used T&M instruments

Digital multimeters are used to measure DC/AC voltage, current, resistance, and continuity in electrical and electronic circuits. The cost of a typical good quality DMM is around $150. More expensive DMMs can also be used for precision measurements, and perhaps to measure semiconductors devices such as diodes and transistors. Some DMMS can even measure the ambient temperature and frequency of an external signal.

An oscilloscope is used to display the waveform of a signal in real-time as well as measure its various parameters, such as the frequency, phase, amplitude, etc. Most engineers nowadays use digital oscilloscopes where the waveforms are displayed, analysed, and saved on a PC. The cost of a good quality middle range oscilloscope can be around $200, while top range professional oscilloscopes can cost hundreds more dollars.

Signal generators are used to generate various signals with different waveforms, amplitudes, and frequencies. For example, sine waves, square waves, sawtooth waves, triangular waves etc. PC based signals generators are also available where the device is configured entirely on a PC screen. The cost of a basic signal generator depends on its frequency range and its precision and can be around $100.

Spectrum analysers are important T&M instruments found in most electronic laboratories and research centres. Signals in real-time can be complex and can be made up of many frequencies, such as harmonics. A spectrum generator is used to display the frequency components and amplitudes of all frequencies contributing to a given signal. The cost of a basic spectrum analyser is in the range $200 to $500.

Logic analysers are commonly used in modern digital electronics and computer laboratories. These instruments for example can be used to capture, display, and analyse digital signals in real-time for testing and debugging purposes.

A frequency counter is basically a digital instrument that is used to measure and display the frequency (and period) of a signal applied to its inputs. The cost of a basic frequency counter is around $100.

LCR meters are portable instruments used to measure and display the inductance (of a coil), capacitance (of a capacitor), and resistance (of a resistor). The cost of an LCR meter depends on its range and accuracy and it can cost around $250.

Bode plotters are used to plot the frequency response and phase of an electronic circuit transfer function. The vertical axis is usually in decibels and the horizontal axis is logarithmic in frequency. Although a Bode plotter can be purchased separately as an instrument, some oscilloscopes or other T&M instruments incorporate bode plotters as well.

As can be seen in Figure 1.1, in general all T&M instruments have common properties: they have hard or soft buttons, switches, knobs, displays etc and they are usually independent standalone instruments.

Red Pitaya is a low-cost board slightly bigger than a credit card and it combines all of the T&M instruments described above. As shown in Figure 1.2, the Red Pitaya board has no buttons, switches, knobs or displays. In order to use Red Pitaya as a T&M instrument, you need to connect it to a PC or network and access it via your browser. The user can then choose the type of instrument required from the web browser as a virtual instrument and configure it as desired by controlling the virtual buttons, knobs, and switches displayed on the screen. Connections to the external world is done using oscilloscope leads connected to the Red Pitaya ports.

The Red Pitaya is thus a multi-instrument T&M board built on a small PCB, and is interfaced to external world via oscilloscope leads and GPIO ports available at its connectors. The GPIO ports at the connectors can be interfaced to external hardware (e.g. to LEDS, buttons, motors, sensors, displays) and they can be programmed using a suitable programming language (e.g. Python) so that the external hardware can be monitored or controlled. Thus, instead of spending tens of thousands of dollars to purchase the basic T&M instruments, one can purchase a Red Pitaya to configure and use it as one of the T&M instruments shown in Figure 1.2.

Red Pitaya additionally incorporates an FPGA that can be programmed to represent any type of digital or analog circuit. The use and programming of the FPGA is discussed at a later chapter of the book.

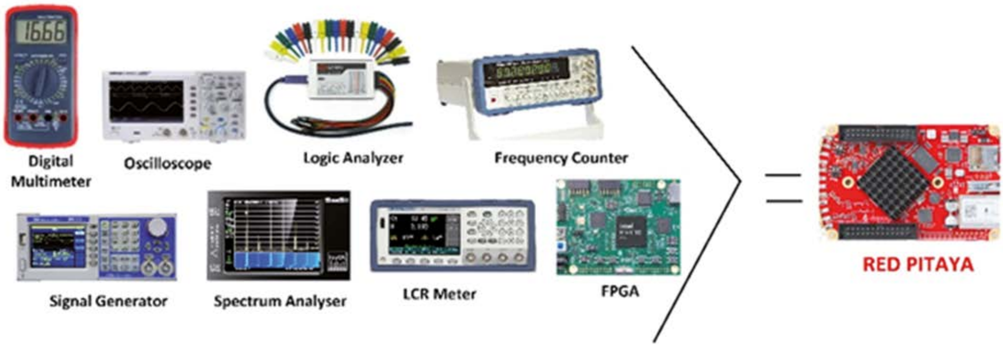

Figure 1.2 Red Pitaya board replaces many T&M instruments

In this book we will concentrate on the **Red Pitaya Gen 2** which is the latest version at the time of writing this book.

1.3 What's in the box?

The Red Pitaya distribution box includes the following parts (see Figure 1.3):

- 1 x Red Pitaya board
- 2 x 60 MHz oscilloscope probes
- 2 x Adapters, SMA-M to BNC-F
- 1 x micro USB power supply adapter
- 1 x 32 GB microSD card with adapter
- 1 x Ethernet cable

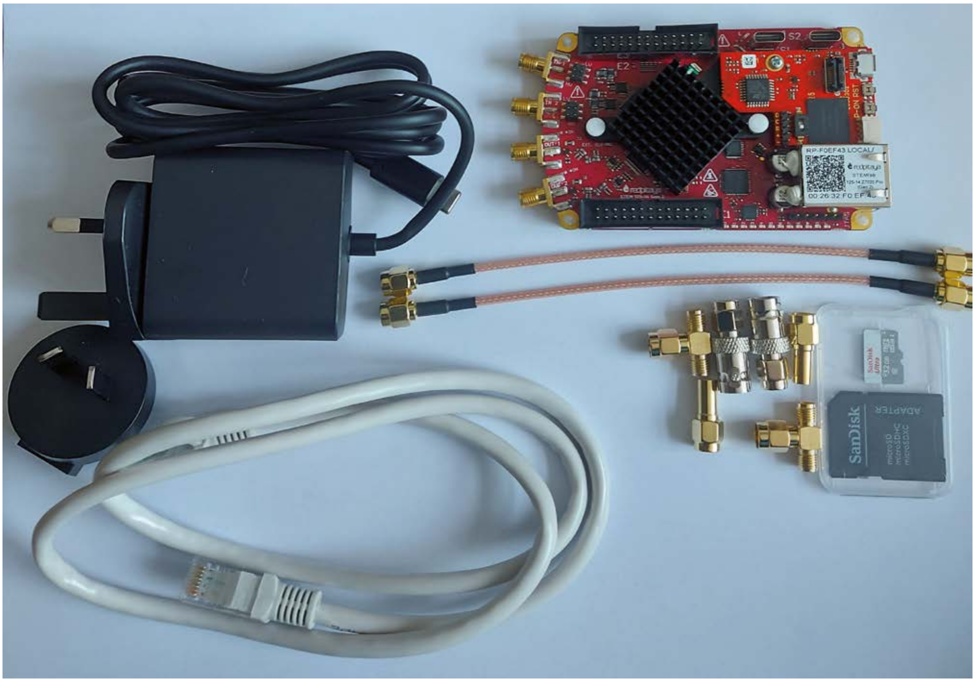

Figure 1.3 Contents of the distribution box

One can purchase additional boards depending on the type of instrument required:

- **Impedance analyser extension board**: Used to make LCR measurements.
- **Sensor extension module**: Plugs on top of the Red Pitaya board and enables users to interact with over 30 sensors, indicators, and actuators.
- **Logic analyser**: Used to turn the Red Pitaya into a logic analyser.
- **Click shield extension module**: Enables to extend the Red Pitaya hardware by including two Mikroe Click boards (www.mikroe.com)
- **Extension module template**: This board enables easy access to the Red Pitaya ports.
- **SDR module**: This is the Software Defined Receiver module which provides SDR transceiver functions.
- **Red Pitaya casing**: Plastic and aluminium casings are available for the Red Pitaya to protect the on-board electronics.

1.4 Red Pitaya Gen 2

There are three variants of the Red Pitaya Gen 2:

- STEMlab 125-14 GEN 2
- STEMlab 125-14 PRO GEN 2
- STEMlab 125-14 PRO Z7020 GEN 2

The differences between these variants are described in detail at the following web site:

https://redpitaya.com/stemlab-125-14-gen2/

You can also purchase Red Pitaya kits from the Red Pitaya shop with various components. Some kits are:

- STEMlab 125-14 Starter Kit
- SDRlab 122-16 Standard Kit
- STEMlab 125-14 Low Noise Starter Kit
- STEMlab 125-14 Diagnostic Kit
- STEMlab 125-14 Edu Pack
- STEMlab 125-14 Ultimate Kit
- STEMlab 125-14 External Clock Starter Kit
- STEMlab 125-14 Calibrated Kit

In this book we will be using the basic **STEMlab 125-14 GEN 2**. This board represents a major leap in performance, precision, and OEM integration flexibility. Designed for modern engineers, researchers, and developers, it offers a compact, open-source platform with upgraded hardware throughout. This generation features an enhanced analog design for better signal integrity, and lower jitter.

The key features of this board are:

- High-performance RF signal acquisition & generation
- Enhanced analog design for reduced noise and jitter
- Xilinx Zynq SoC (CPU + FPGA) with improved RAM for real-time processing
- Up to 4 analog inputs and outputs (depending on model)
- Remote access via web-based apps over Ethernet
- USB-C power input and optional external clocking
- Open-source software stack with Linux shell access
- Works with Linux or Windows PC
- Free online apps (oscilloscope & signal generator, spectrum, Bode analyzer, logic analyzer, LCR meter*, streaming, network manager, and calibration tool)
- Can be controlled remotely using LabVIEW, MATLAB, Python, or Scilab
- Can be programmed to meet custom needs
- An app marketplace with several free apps available
- Ready for prototyping, development, testing, or OEM integration

The base technical specifications are:

• Processor:	Dual-core ARM Cortex-A9
• FPGA:	Xilinx Zynq 7010 SoC
• RAM:	512 MB
• System memory:	Micro SD card up to 32 GB
• Console connection:	USB-C
• Power connector:	USB-C
• Power consumption:	5 V, 3 A max
• Ethernet:	1 Gbit
• Wi-Fi:	External dongle required
• RF input channels:	2
• Sample rate:	125 MS/s
• ADC resolution:	14 bits
• Full scale voltage:	±1V, ±20V
• Input coupling:	DC
• Bandwidth:	DC to 60 MHz
• Input impedance:	1 MOhm
• RF Output Channels:	2
• DAC resolution:	14 bits
• Full scale voltage:	±1V, ±2V
• Load impedance:	50 Ohm or High-Z
• Short circuit protection	
• Rise/fall time:	10V / 17 ns
• Connector type:	SMA

Extension connector:

• Digital GPIOs:	16
• Digital voltage level:	3.3V
• Analog inputs:	4 channels, 0-3.5V
• Analog input sample:	100KS/s
• Analog input:	12 bits
• Analog outputs:	4-channels, 0-1.8V
• Analog output:	8 bits
• Analog out sample:	≤3.2 Msa/s
• Analog out:	180 kHz bandwidth
• Interfaces:	I2C, SPI, UART, CAN
• Available voltages:	±5V, +3.3V
• Trigger input:	E1 connector
• Trigger output:	E1 connector
• SD card boot:	Yes

1.5 Comparison of the original Red Pitaya (Gen 1) and the new Gen 2 models

Table 1.1 shows a comparison of the original Red Pitaya (Gen 1) and the new Gen 2 models. Readers should find this table useful before they make a choice of which model to purchase.

Feature	Original (Gen 1)	Gen 2
Processor	Dual-core ARM Cortex-A9	Dual-core Arm Cortex-A9
FPGA	Xilinx Zynq 7010	Xilinx Zynq 7010
Memory (RAM)	512 MB	512 MB
Core clock frequency	125 MHz	125 MHz
System memory	microSD (up to 32 GB)	microSD (up to 32 GB)
Console connection	microUSB	USB-C
Power connector	microUSB	USB-C
Power supply	5 V 2A	5 V 3 A
Ethernet	1 Gbit	1 Gbit
RF/Analog input	2 channels,125 MS/s,14-bit ADC; ±1V (LV) / ±20 V (HV)	2 channels,125 MS/s,14-bit ADC; ±1V (LV) / ±20 V (HV)
RF/Analog output	2 channels,125 MS/s,14-bit DAC	2 channels,125 MS/s,14-bit DAC
Analog bandwidth	DC – 60 MHz (for input)	DC – 60 MHz (for input)
Extension / GPIO	16 GPIO, 3.3V	16 GPIO 3.3V
High speed differential pairs	E3 connector	Only on Pro / Z7020 Gen 2 variants
Boot/Power management	Standard microSD boot	microSD boot or the QSPI/eMMC boot
Signal quality (analog end)	SFDR – 40 dB crosstalk	Improved SFDR – 50 dB crosstalk
Noise	Good	Lower noise
Environmental	Standard	More rugged / industrial use

Table 1.1 Comparison of the original and Gen 2 models

1.6 Which model to choose?

Table 1.2 below recommends which model to chose based on the type of user.

User	Recommended model
Student / hobbyist	Gen 1
Teaching labs	Gen 1
Tight budget	Gen 1
Home use	Gen 1
Industrial use	Gen 2
Embedded use	Gen 2
FPGA based projects	Gen 2 Pro (Z7020)
Long term projects	Gen 2

Table 1.2 Which model to choose?

Table 1.3 shows thew recommended model to choose based on the type of application.

Application	Gen 1	Gen 2
Teaching labs	Good choice, reliable	Excellent choice
Hobbyist	Ideal, cost-effective	Still suitable. Higher cost
Precision measurement	Moderate precision	Better precision
Scientific research	Suitable	Better and more stable measurements
RF and wireless comms	Adequate	Better SFDR, clearer signal, less crosstalk
DSP	Can be used	Better suited, good for DSP work
Long term projects	Not very future proof	Much more future proof
OEM deployment	Can be used	Excellent, industrial grade

1.7 Red Pitaya Gen 2 board layout

It is important to know the board layout of any development system before designing a project. Figure 1.4a and Figure 1.4b show the Red Pitaya Gen 2 board layout. On the left hand side are two fast analog inputs (RF inputs) where external analog signals that are to be measured or displayed can be connected to. The analog output ports (RF outputs) can be seen at the bottom left hand side of the board. These outputs for example can be configured to generate signals.

The middle part of the board consists of an ARM Cortex A9 processor and an FPGA. The FPGA contains 28,000 logic cells and can perform fast digital signal processing tasks.

Next to the FPGA is 512MB of RAM memory.

On the top and bottom of the board you can see the extension connectors E1 and E2, used to expand the external interface and functionalities of the board. These connectors support various communication protocols such as I2C, RS232, GPIO, CAN, external clock etc.

On the right hand side of the board, you can see the E3 connector (available only on PRO versions, QSPI and eMMC booting option), power connector, microSD card slot, console micro USB port, JTAG connector, and a connector for gigabit Ethernet interface.

The board operates with +5V and can draw up to 2A current. It is therefore important that the external power supply provided with the kit is used (do not supply power from your PC).

The Linux operating system is by default pre-loaded on the microSD card.

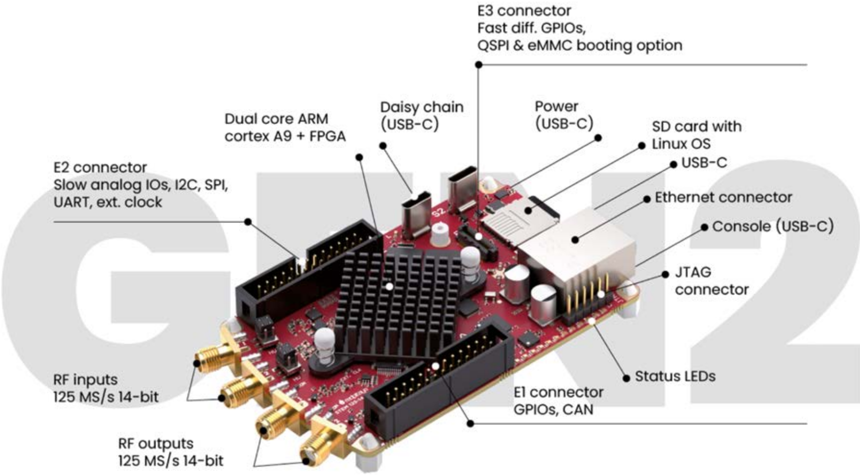

Figure 1.4a Red Pitaya Gen 2 board layout

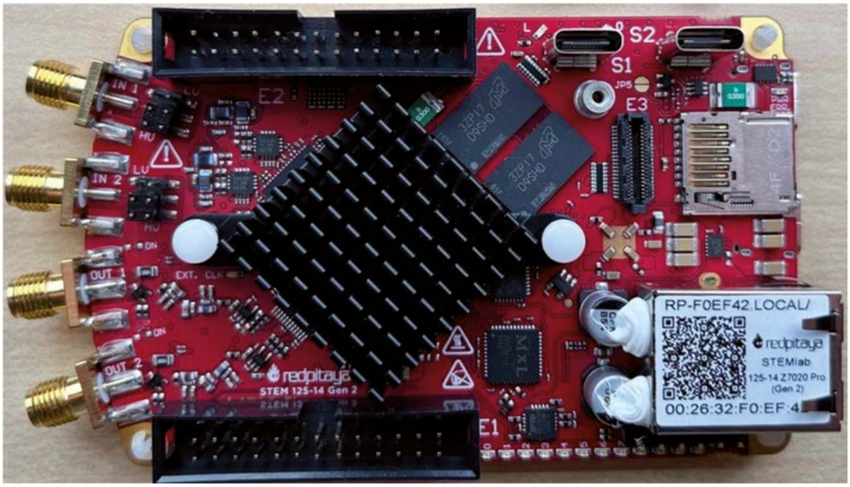

Figure 1.4b Red Pitaya Gen 2 board closeup photo

Figure 1.5 shows the pin configurations of the E1 and E2 extension connectors.

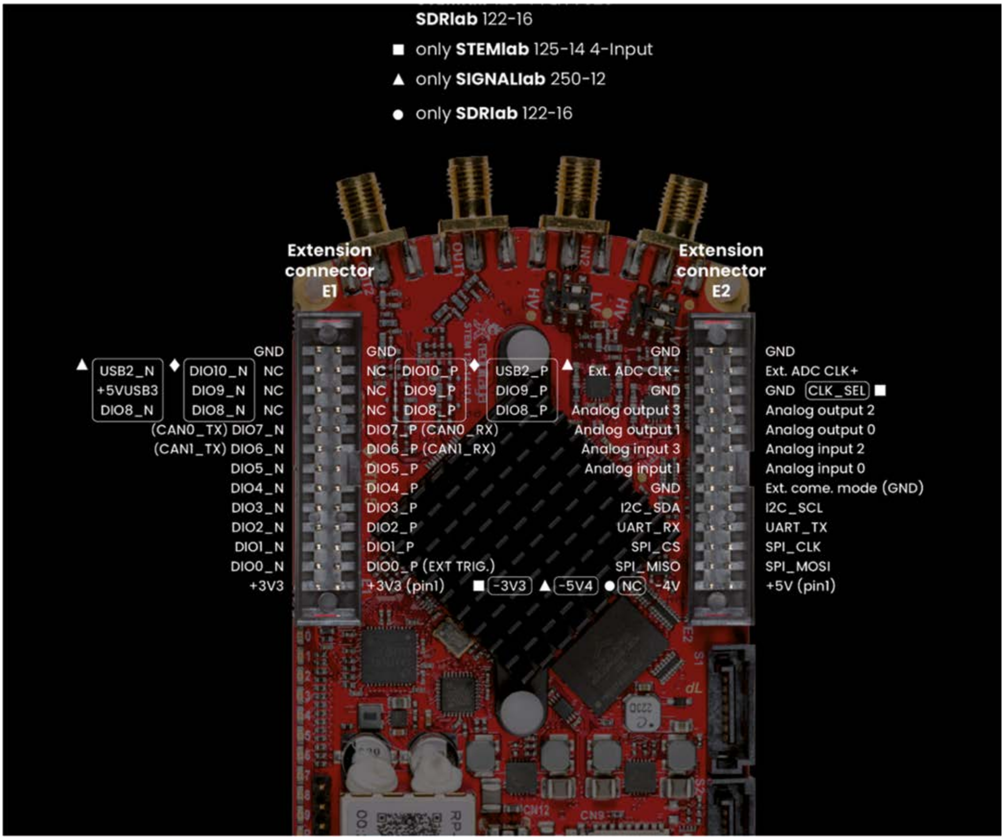

Figure 1.5 E1 and E2 extension connectors

1.8 Typical applications

Red Pitaya's FPGA side ships with reference modules—oscilloscopes, spectrum analysers, filters, PID controllers, and arbitrary waveform generators. You can customize or replace any of these to build:

- Digital Oscilloscope - with realtime waveform analysis and capture
- Signal & Function Generators - up to 125 MHz (or 250 MHz)
- Communications
- Remote scope meters
- Automated testing
- Automated signal logging
- Hardware simulation of digital systems
- Ham radio
- Electronic research
- Portable measurement and test tools
- Protocol analyzer

- Spectrum Analyzer - via onFPGA FFT cores
- Custom DSP Accelerators - e.g., FIR/IIR filters with variable coefficients
- Control Systems - PID loops running entirely in hardware
- Electronic hobbyists – carrying out practical electronic projects
- Education Kits - handson FPGA teaching tools
- Embedded Instruments - integrated measurement devices for labs and field use

1.9 QSPI eMMC board

The QSPI eMMC board (Figure 1.6) provides secure and robust Red Pitaya boot and shutdown options.

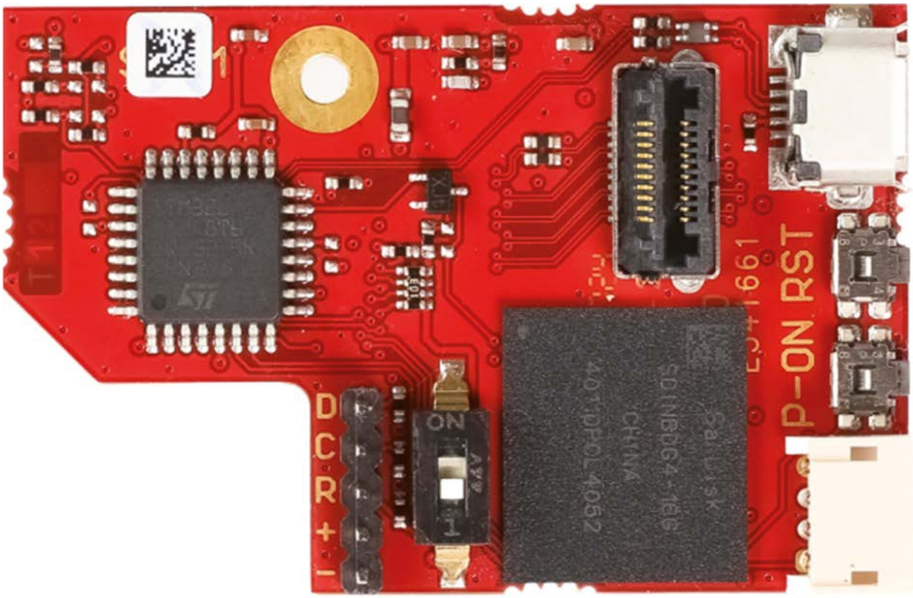

Figure 1.6 The QSPI eMMC board

This board features:

- Single button power on/off of Red Pitaya board.
- QSPI and eMMC boot options.
- On-board STM microcontroller that provides.
  - Red Pitaya power up.
  - Safe Red Pitaya shutdown.
  - Watchdog timer functionality.
  - Boot media selection (SD card/eMMC).
- Arduino (C++) firmware with open source code.
- Connector for 8 high-speed differential pairs directly connected to the Zynq 7020 FPGA (16 GPIOs).

The QSPI eMMC module is powered by the Red Pitaya board, so no additional power supply is needed.

The Red Pitaya hardware requirements to use this board are:

- STEMlab 125-14 Pro Gen 2.
- STEMlab 125-14 Pro Z7020 Gen 2.

Buttons and switches on the board

As shown in Figure 1.7, there are two buttons (1 and 2) and a switch (3) on the board with the following functions:

1. **P-ON** - Power button. Press and hold to power on or off the Red Pitaya board. The functionality of the button is defined in the microcontroller firmware.

2. **RST** - Reset button. Press to reset the microcontroller and the eMMC.

3. **eMMC switch** - Drives the SDIO_SEL pin low in ON position and forces the Red Pitaya board to boot from the eMMC.

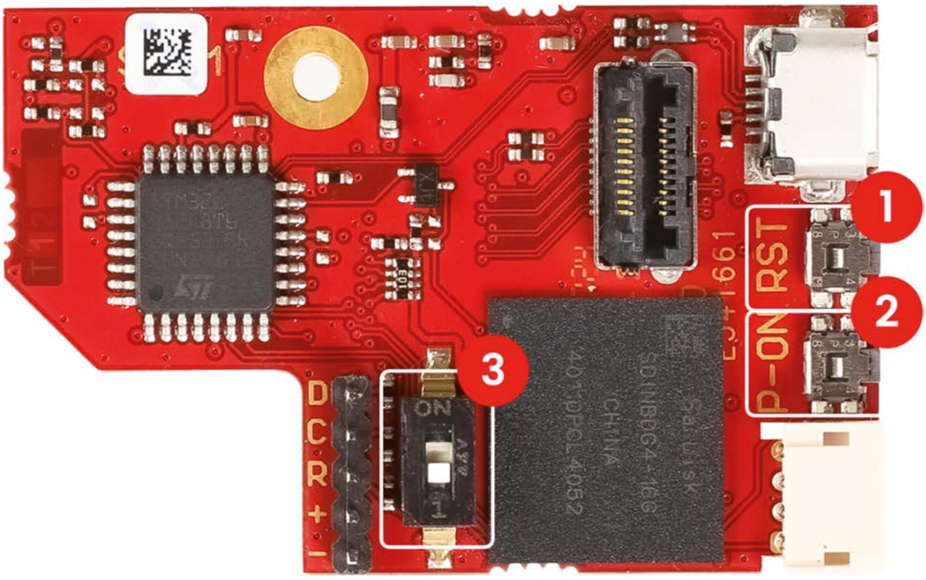

Figure 1.7 Buttons and switches on the board

Connectors on the board

Figure 1.8a and Figure 1.8b show the connectors on the board.

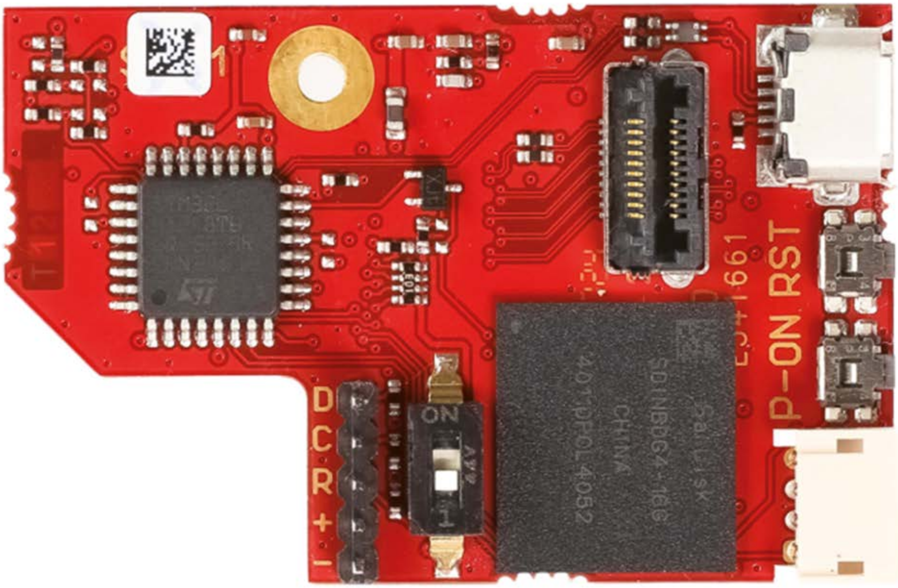

Figure 1.8a Connectors on the front

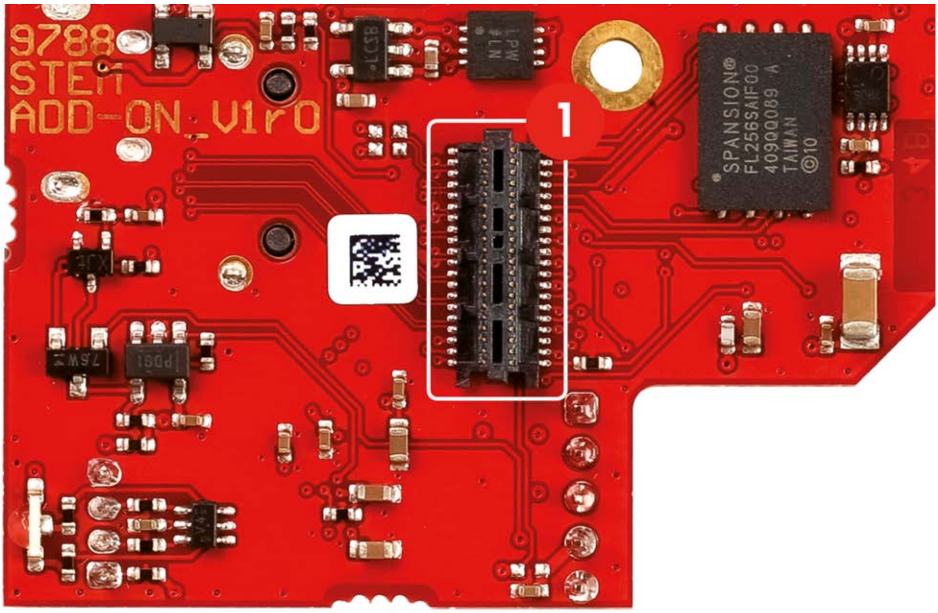

Figure 1.8b Connectors at the rear

Connector 1 (CN1):
40-pin 2 row 0.5 mm pitch connector.

Connects QSPI eMMC module to Red Pitaya board. It has the following pins:

- QSPI pins.
- eMMC pins.
- I2C.
- 8 LVDS differential pair lines (16 GPIOs) (only for STEMlab 125-14 Pro Z7020 Gen 2).
- Power and control signals.

Connector 2 (CN2):
4-pin 1 row 1.5 mm pitch connector

CN2 connector provides a possibility for external control of status LEDs and power pin (PWR_ON_CN). The microcontroller code accepts signals from either PWR_ON_CN pin or the P_ON button, which are effectively AND-ed together in the code.

Pin	Description
1	PWR_ON_CN
2	LED GREEN
3	LED RED
4	GND

Connector 4 (CN4):
micro USB connector

Connector CN4 is used to program the STM microcontroller on the QSPI eMMC module. It provides a USB connection to the STM microcontroller.

Pin	Description
1	VCC
2	D-
3	D+
4	ID
5	GND
6	SHIELD

Connector 5 (CN5):
20-pin 2 row 0.5 mm pitch connector.

The CN5 connector is directly connected to the 8 high-speed differential pairs on the Zynq FPGA. It can be used to connect to external devices.

Pin	Description	Description	Pin
1	DIO15_P	DIO17_P	2
3	DIO15_N	DIO17_N	4
5	DIO14_P	DIO11_P	6
7	DIO14_N	DIO11_N	8
9	DIO16_P	DIO13_P	10
11	DIO16_N	DIO13_N	12
13	DIO18_P	GND	14
15	DIO18_N	GND	16
17	DIO12_P	GND	18
19	DIO12_N	GND	20

The shield pin is connected to the ground plane on the QSPI eMMC module.

Connector 7 (CN7):
5-pin 1 row 2.00 mm pitch connector

Serial Wire Debug connector for programming the STM microcontroller.

Pin	Label	Description
1	D	SWDIO
2	C	SWCLK
3	R	SWD_RES
4	Plus (+)	VCC
5	Minus (-)	GND

Components:
The QSPI eMMC module is equipped with the following components:

- STM32L412K8T6
- eMMC - 16 GB eMMC memory.
- QSPI

1.10 Acrylic and aluminium cases

An acrylic case is available to protect your Red Pitaya. An aluminium case is also available and is preferable since it helps with cooling the device. Both types of cases are shown in Figure 1.9

Figure 1.9 Acrylic and aluminium cases

1.11 Summary

In this chapter you have learned what Red Pitaya Gen 2 is, its basic features, its board layout, and its typical applications.

Chapter 2 • Red Pitaya Extension Modules

2.1 Overview

The Red Pitaya provides (in addition to its built-in analog I/O and FPGA/CPU) **extension connectors** (often labelled E1, E2, E3, etc.) which to allow external modules (or "shields", "extension boards") to interface with it. Extension modules expand the usability of Red Pitaya: sensors, measurement instruments (LCR meter, logic analyzer, etc.), preconditioning circuits, shields for Arduino compatibility, external ADC clocking, etc.

Some examples of extension modules are:

Some examples of extension modules (including third-party) that we will look at briefly in this chapter include:

- Impedance Analyzer Extension Module (or the LCR meter module)
- Logic Analyzer Extension Module
- Sensor Extension Module (Grove / Arduino compatible)
- Vector Network Analyzer Module
- Impedance Transformer Extension Module
- Red Pitaya Click Shield
- ECG Shield / Biosignal module
- HDMI output shield
- Ground-penetrating radar shield

2.2 Impedance Analyzer Extension Module

The Impedance Analyzer Extension Module (Figure 2.1) is an extension module (sold by Red Pitaya) plus a software/web app on Red Pitaya that lets you use your board as a lab instrument to measure impedance (Z), resistance (R), capacitance (C), inductance (L), and associated parameters, such as phase, Q, dissipation factor, etc. Once the module is present, the measurement interface is accessed via a web browser (Red Pitaya apps are web-based), so you don't need special desktop software.

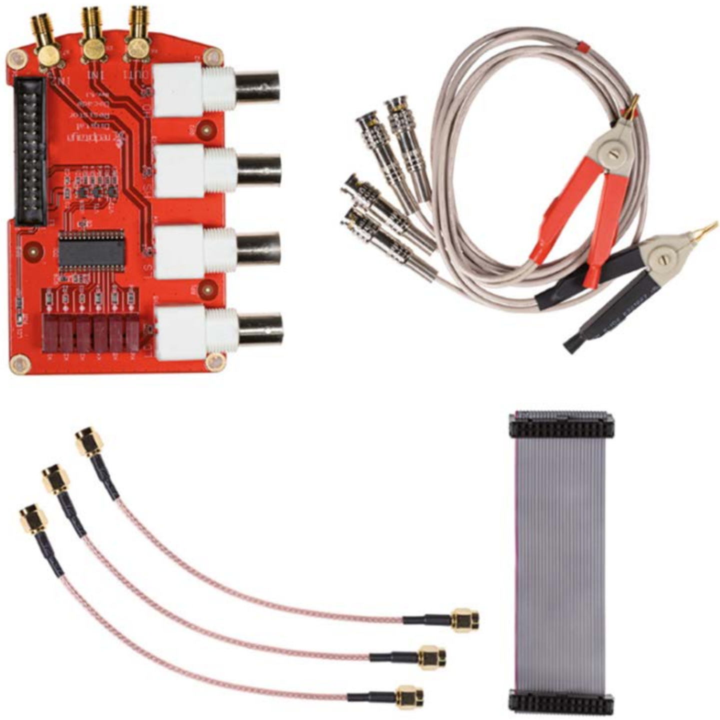

Figure 2.1 Impedance Analyzer Extension Module

The basic specifications of this module are:

Frequencies supported:	100 Hz, 1 kHz, 10 kHz, 100 kHz
Resistance range:	1 Ω to 10 MΩ
Inductance range:	100 nH to 1000 H
Capacitance range:	1 pF to 100 mF
Max input voltage:	0.5 Vpp
Measurement accuracy:	1.00 %
Input protection:	Overvoltage protection
Range selection:	Manual and auto
Logging/export:	You can log up to 1000 measurements, view min/max/ average, and export in CSV format

Advantages:

- Low cost
- Integration into Red Pitaya
- Web interface

Disadvantages:

- Input limited to 0.5 Vpp
- Accuracy is only about 1%
- Measurements done using only four discrete frequencies

2.3 Logic Analyzer Extension module

The Logic Analyzer Module (Figure 2.2) allows Red Pitaya to sample multiple digital signals simultaneously (e.g. GPIO, buses) and decode digital communication protocols (UART, SPI, I^{2}C, CAN). This functionality is exposed via a web based interface so no special desktop software is needed.

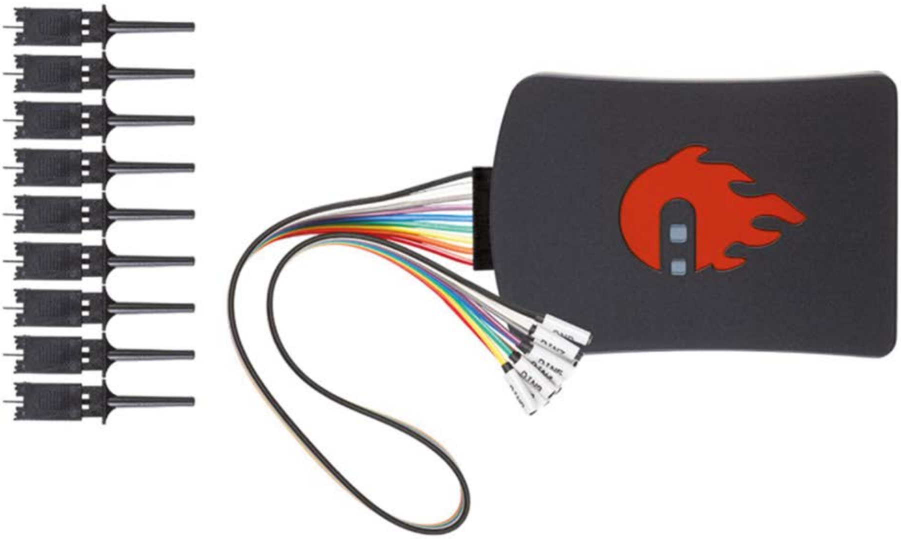

Figure 2.2 Logic Analyzer Extension Module

The basic specifications of this module are:

Channels:	8
Sampling rate:	Up to 125 MS/s
Maximum input freq:	50 MHz
Input voltage:	2.5 V to 5.5V
Input protection:	Overvoltage protection
Input impedance:	100 kΩ in parallel with 3 pF capacitor
Memory depth:	1 MS
Minimum pulse:	Shortest digital pulse that can be captured 10 ns