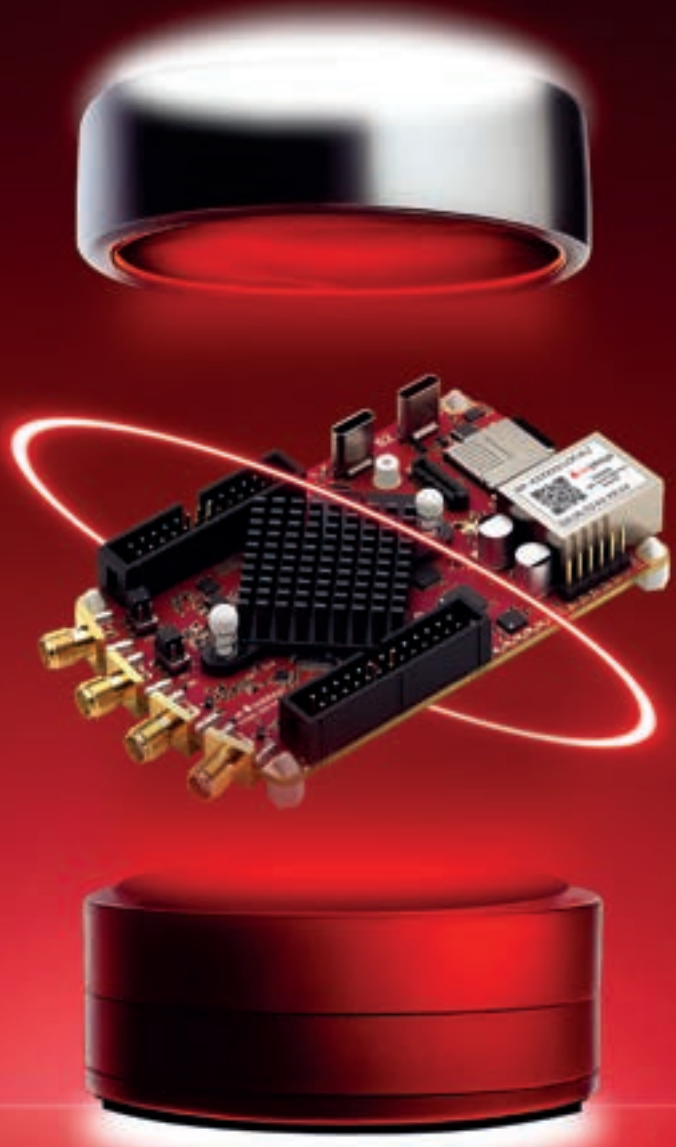
redpitaya

Swiss Army Knife
for Engineers

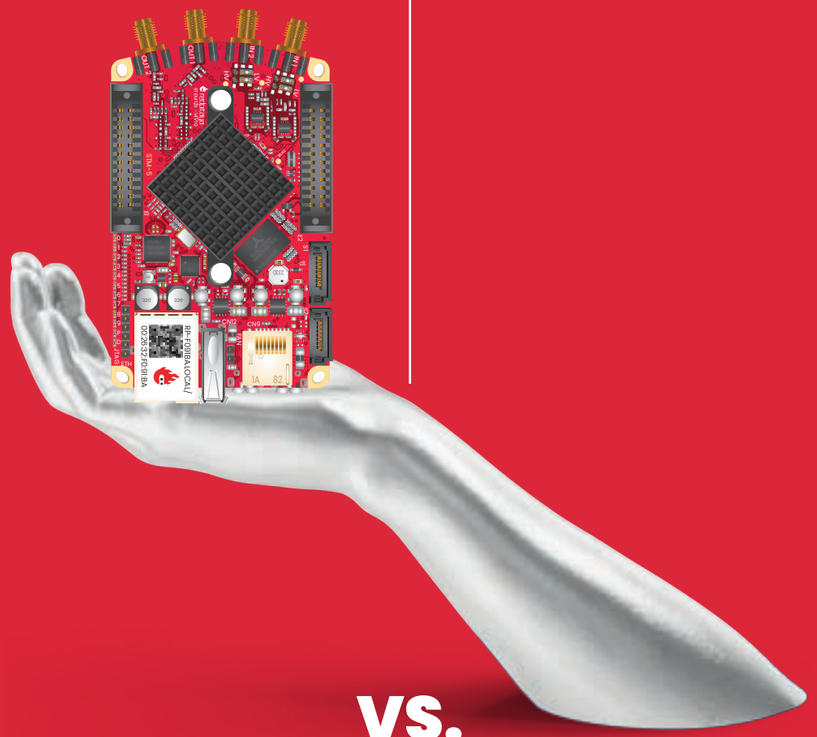


GEN 2

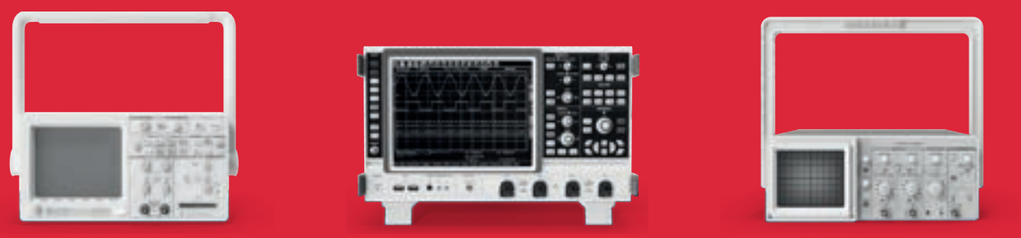
Built for Industry,
Engineered for Innovation

REPLACE YOUR
LAB INSTRUMENTS

One open-source platform that will replace bulky and expensive instruments?
Meet Red Pitaya, and step on this revolutionary road!



vs.



And many more!

THE RED PITAYA
ECOSYSTEM

HARDWARE

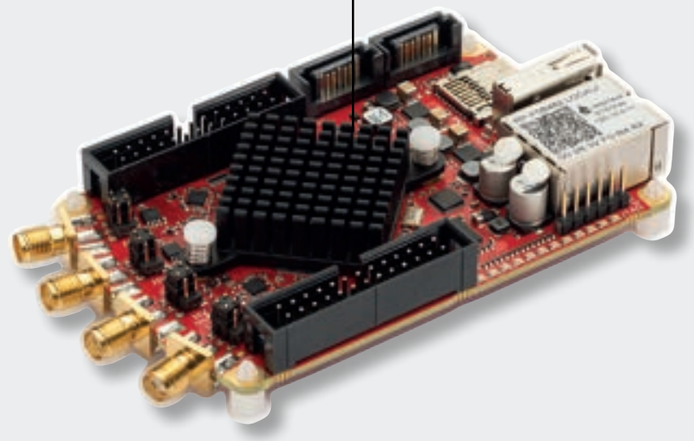
- flexible sample rate, resolution
- flexible number of channels
- cost optimized variants
- easy to integrate as OEM

SOFTWARE

- open-source
- C APIs, Python, LabVIEW, MATLAB
- WEB UI
- community projects & applications

INSTRUMENTS

- oscilloscope
- spectrum analyzer
- signal generator
- lock-in amplifiers
- PID controller
- sweep generators
- digital mixers
- tunable bandpass filters



Applications for your **RED PITAYA**

All the applications are web-based, FREE of charge and available when purchasing a board.

Oscilloscope & Signal generator

Spectrum analyzer

LCR meter

Bode analyzer

Logic analyzer

Vector network analyzer

An intuitive **USER INTERFACE**

Red Pitaya uses a web interface and all the software is running on the board, there's no need to install any proprietary software to get started. All you have to do is open your web browser, connect to the board and select which application you want to run.

Remote control

Your Red Pitaya board can be controlled remotely over LAN or wireless.

Python

Control your Red Pitaya with Python – the most popular script language used by researchers working on the fast development of any engineering application that requires testing, measurement, control & signal processing

MATLAB

Control your Red Pitaya with MATLAB – the easiest and most productive software environment for engineers and scientists. The perfect combination to speed up your research, prototyping and testing.

LabVIEW

Control your Red Pitaya with LabVIEW – software designed for the fast development of any engineering application that requires testing, measurement, or control.

Programming

For those who would like to program their own applications, we have provided C and Python APIs that enable super easy access to all Red Pitaya features, while more advanced users can also create and run their own FPGA logic.

Jupyter Notebook / Python

Jupyter Notebook enables you to execute Python code and control Red Pitaya hardware features, visualize data and add explanatory text or write interactive documents directly in a web browser Jupyter Notebook Python editor.

C API

A list of built-in C code functions (APIs) provides full control over the Red Pitaya board (signal generation & acquisition, digital I/O control, communication: I2C, SPI, UART, and others).

FPGA

Examples of Red Pitaya FPGA code include complete control logic over signal acquisition, generation and more, along with all image build instructions and register map documentation. The code is free & available on Github.

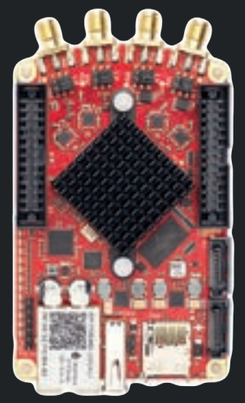
Product
HIGHLIGHTS

STEMlab 125-14

STEMlab 125-14 is our most versatile and popular product, providing perfect value for money.

More variants available:

Zynq 7020 Low Noise | External Clock | ISO17025 | Low Noise | OEM



STEMlab 125-14 4-Input

STEMlab 125-14
4-Input has four inputs at 125 MS/s 14-bit
Internal/external clock selector available
Performance improvements
(less noise & crosstalk)
FPGA AMD Xilinx Zynq 7020 SoC

SIGNALlab 250-12

SIGNALlab 250-12 is the most sophisticated Red Pitaya product, built for more demanding industrial applications and research.

OEM

SDRlab 122-16

SDRlab 122-16 was developed specifically for software-defined radio and more demanding RF applications.

External Clock

GET READY FOR GEN 2

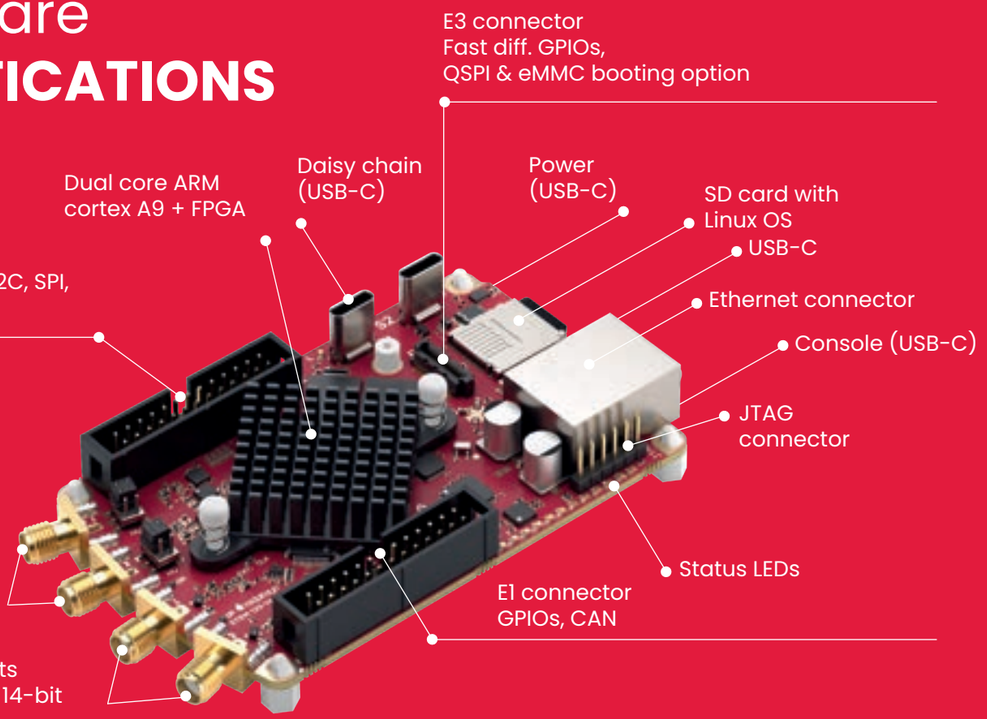
STEMlab 125-14 Gen 2

STEMlab 125-14 Pro Gen 2

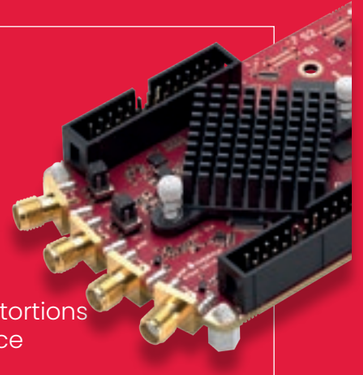
STEMlab 125-14 Pro Z7020 Gen 2

Hardware **SPECIFICATIONS**

GEN 2



STEMlab 125-14 Gen 2



The next-generation STEMlab 125-14, now with:

- **Enhanced RF input performance** – Reduced noise, cross-talk, and distortions
- **Improved output voltage range** – ±1 V at 50 Ω, ±2 V at high impedance
- **USB-C connectors** – Modern, reliable connectivity
- **Same compact design** – Maintains connector positions for easy integration
- **100% software & FPGA backward compatibility** – Seamless upgrade path

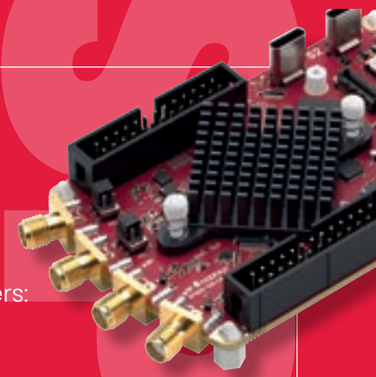
Users

- Researchers and students in engineering, physics, and applied sciences
- Makers, electronics enthusiasts, and DIY project builders
- Teachers and trainers in technical fields, who can use it for demonstrations and practical labs

Applications

- A teaching tool for electrical engineering and programming
- Signal acquisition, generation and processing
- Embedded systems development

STEMlab 125-14 Pro Gen 2



Industry-ready and built for demanding applications, the Pro Gen 2 offers:

- **E3 connector**, providing more robust booting options (QSPI, eMMC)
- **Onboard external clock selector**
- **Multi-channel synchronization**

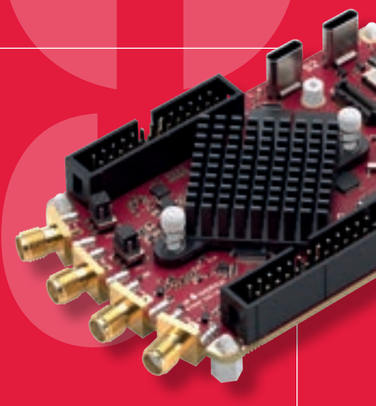
Users

- Industry professionals
- Engineers and technicians in manufacturing and quality assurance
- Researchers

Applications

- Testing and measurement
- Radar systems development
- Nondestructive testing (NDT)
- OEM solutions

STEMlab 125-14 Pro Z7020 Gen 2



Built for the most demanding industrial applications, now with:

- **Two times more DDR** (1 GB) – Longer capture times
- **Three times bigger FPGA** – Z7020
- **Six more GPIOs on E1**
- **Eight additional high-speed differential pairs on E3**

Users

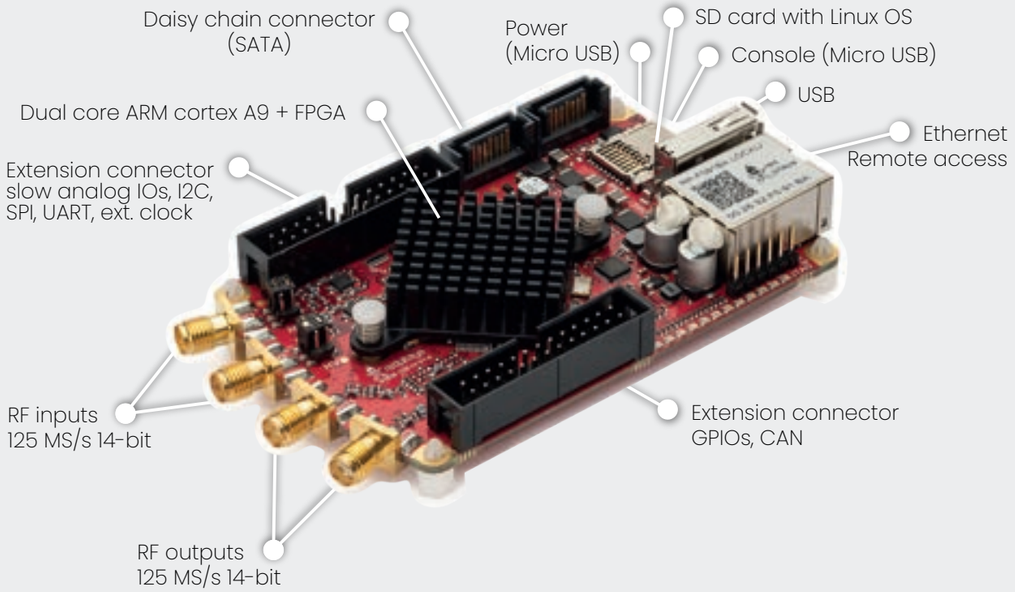
- Industry professionals
- Scientific researchers

Applications

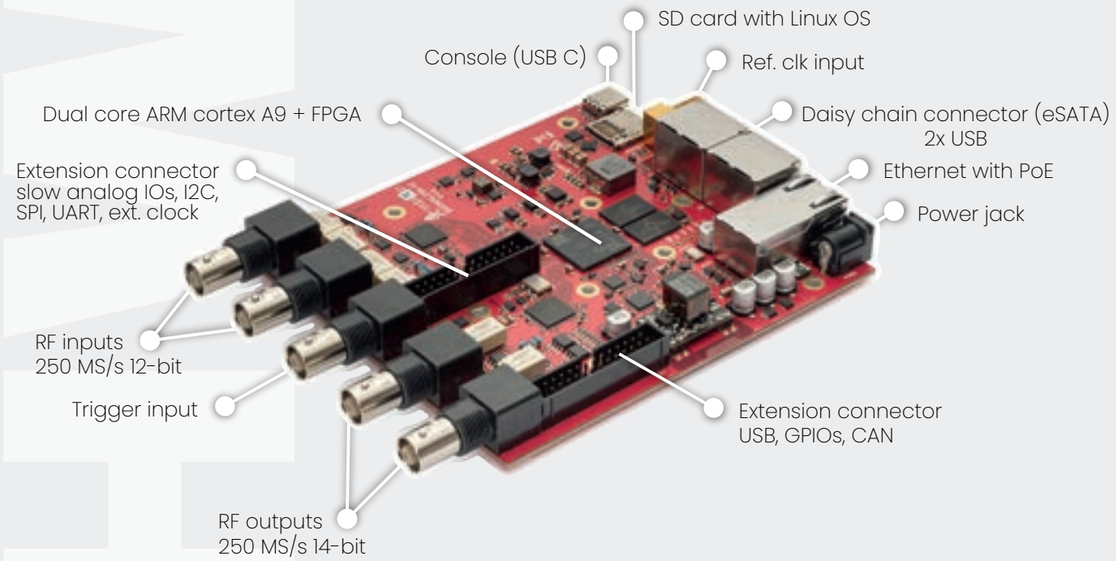
- Quantum computing experiments
- Photonic applications
- Medical imaging technologies
- Space applications
- Advanced OEM solutions

Hardware
SPECIFICATIONS

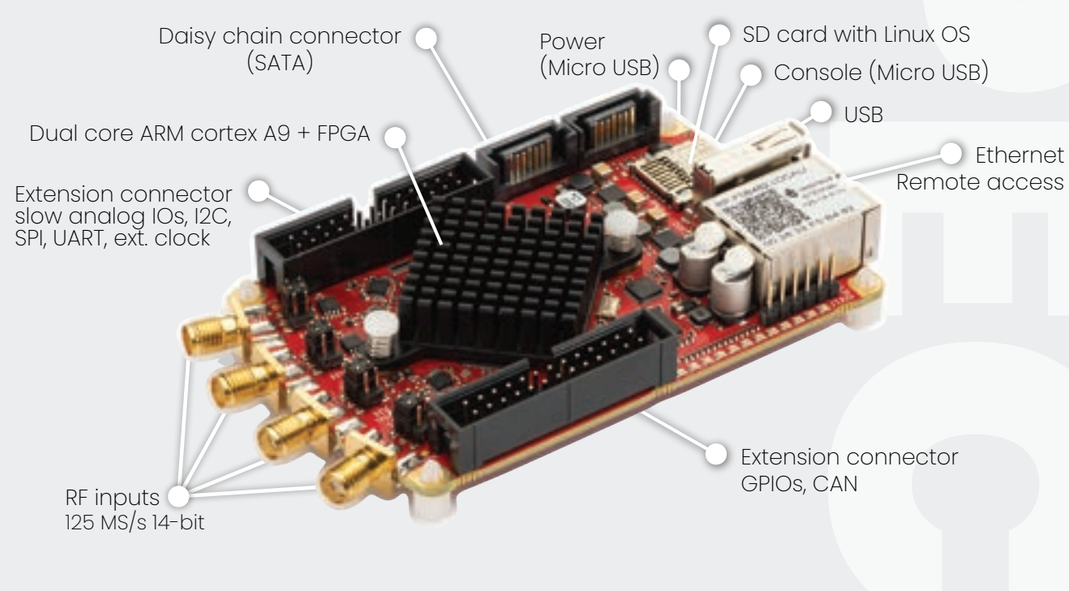
STEMlab 125-14



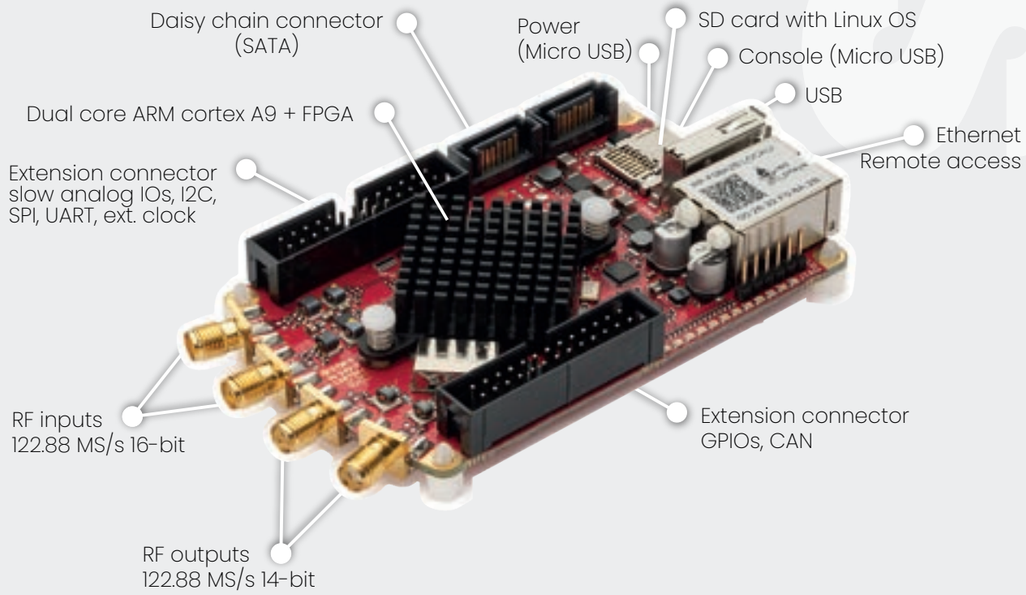
SIGNALlab 250-12



STEMlab 125-14 4-Input



SDRlab 122-16



Compare our products

	STEMlab 125-14 STEMlab 125-14 LN STEMlab 125-14 ext. clk STEMlab 125-14 X-Channel System	STEMlab 125-14 Z7020 LN	STEMlab 125-14 4-Input	SDRlab 122-16 SDRlab 122-16 ext. clk	SIGNALlab 250-12
BASIC					
Processor	DUAL CORE ARM CORTEX A9	DUAL CORE ARM CORTEX A9	DUAL CORE ARM CORTEX A9	DUAL CORE ARM CORTEX A9	DUAL CORE ARM CORTEX A9
FPGA	FPGA AMD Xilinx Zynq 7010 SoC	FPGA AMD Xilinx Zynq 7020 SoC	FPGA AMD Xilinx Zynq 7020 SoC	FPGA AMD Xilinx Zynq 7020 SoC	FPGA Xilinx Zynq 7020 SOC
RAM	512 MB (4 Gb)	512 MB (4 Gb)	512 MB (4 Gb)	512 MB (4 Gb)	1 GB (8 Gb)
System memory	Micro SD up to 32 GB	Micro SD up to 32 GB	Micro SD up to 32 GB	Micro SD up to 32 GB	Micro SD up to 32 GB
Console connection	Micro USB	Micro USB	Micro USB	Micro USB	USB-C
Power connector	Micro USB	Micro USB	Micro USB	Micro USB	Power jack, RJ45 (PoE version only)
Power consumption	5 V, 2 A max	5 V, 2 A max	5 V, 2 A max	5 V, 2 A max	24 V, 0.5 A max
CONNECTIVITY					
Ethernet	1 Gbit	1 Gbit	1 Gbit	1 Gbit	1 Gbit
USB	USB 2.0	USB 2.0	USB 2.0	USB 2.0	2x USB 2.0
Wi-Fi	Requires Wi-Fi dongle	Requires Wi-Fi dongle	Requires Wi-Fi dongle	Requires Wi-Fi dongle	Requires Wi-Fi dongle
RF INPUTS					
RF input channels	2	2	4	2	2
Sample rate	125 MS/s	125 MS/s	125 MS/s	122.88 MS/s	250 MS/s
ADC resolution	14 bit	14 bit	14 bit	16 bit	12 bit
Input impedance	1 MΩ / 10 pF	1 MΩ / 10 pF	1 MΩ / 10 pF	50 Ω	1 MΩ
Full scale voltage range	±1 V (LV) and ±20 V (HV)	±1 V (LV) and ±20 V (HV)	±1 V (LV) and ±20 V (HV)	0.5 Vpp / -2 dBm	±1 V / ±20 V (software selectable)
Input coupling	DC	DC	DC	AC	AC / DC (software selectable)
Absolute max. input voltage	±6 V (LV) and ±30 V (HV)	±6 V (LV) and ±30 V (HV)	±6 V (LV) and ±30 V (HV)	50 VDC / 0.5 Vpp VAC	±6 V (LV) and ±30 V (HV)
Input ESD protection	Yes	Yes	Yes	Yes	Yes
Overload protection	Protection diodes	Protection diodes	Protection diodes	DC voltage protection	Protection diodes
Bandwidth	DC - 60 MHz	DC - 60 MHz	DC - 60 MHz	300 kHz - 550 MHz	DC - 60 MHz
RF OUTPUTS					
RF output channels	2	2	N/A	2	2
Sample rate	125 MS/s	125 MS/s	N/A	122.88 MS/s	250 MS/s
DAC resolution	14 bit	14 bit	N/A	14 bit	14 bit
Load impedance	50 Ω	50 Ω	N/A	50 Ω	50 Ω
Voltage range	±1 V	±1 V	N/A	0.5 Vpp / -2 dBm	±2 V / ±10 V Hi-Z (software selectable)
Short circuit protection	Yes	Yes	N/A	N/A, RF transformer & AC-coupled	Yes
Connector type	SMA	SMA	N/A	SMA	BNC
Output slew rate	2 V / 10 ns	2 V / 10 ns	N/A	N/A	10 V / 17 ns
Bandwidth	DC - 60 MHz	DC - 60 MHz	N/A	300 kHz - 60 MHz	DC – 60 MHz
EXTENSION CONNECTOR					
Digital IOs	16	22	22	22	19
Analog inputs	4	4	4	4	4
Analog inputs voltage range	0 - 3.5 V	0 - 3.5 V	0 - 3.5 V	0 - 3.5 V	0 - 3.5 V
Sample rate	100 kS/s	100 kS/s	100 kS/s	100 kS/s	100 kS/s
Resolution	12 bit	12 bit	12 bit	12 bit	12 bit
Analog outputs	4	4	4	4	4
Analog outputs voltage range	0 - 1.8 V	0 - 1.8 V	0 - 1.8 V	0 - 1.8 V	0 - 1.8 V
Communication interfaces	I2C, SPI, UART, CAN	I2C, SPI, UART, CAN	I2C, SPI, UART, CAN	I2C, SPI, UART, CAN	I2C, SPI, UART, USB, CAN
Available voltages	+5 V, +3,3 V, -4 V	+5 V, +3.3 V, -4 V	+5 V, +3.3 V, -4 V	+5 V, +3.3 V, -4 V	+5 V, +3.3 V, -4 V
External ADC clock	Yes	Yes	Yes	Yes	Yes
SYNCHRONIZATION					
Trigger input	Through extension connector	Through extension connector	Through extension connector	Through extension connector	Through BNC connector
Daisy chain connection	SATA connectors (up to 500 Mb/s)	SATA connectors (up to 500 Mb/s)	SATA connectors (up to 500 Mb/s)	SATA connectors (up to 500 Mb/s)	SATA connectors (up to 500 Mb/s)
Ref. clock input	N/A	N/A	N/A	N/A	Through SMA connector

	STEMlab 125-14 (Gen 1)	STEMlab 125-14 Gen 2	STEMlab 125-14 Pro Gen 2	STEMlab 125-14 Pro Z7020 Gen 2
BASIC				
Processor	DUAL CORE ARM CORTEX A9	DUAL CORE ARM CORTEX A9	DUAL CORE ARM CORTEX A9	DUAL CORE ARM CORTEX A9
FPGA	FPGA Xilinx Zynq 7010 SoC	FPGA Xilinx Zynq 7010 SoC	FPGA Xilinx Zynq 7010 SoC	FPGA Xilinx Zynq 7020 SoC
RAM	512 MB (4 Gb)	512 MB (4 Gb)	512 MB (4 Gb)	1 GB (8 Gb)
System memory	Micro SD up to 32 GB	Micro SD up to 32 GB	Micro SD up to 32 GB	Micro SD up to 32 GB
Console & power connection	Micro USB	USB-C	USB-C	USB-C
Power consumption	5 V, 2 A max	5 V, 3 A max	5 V, 3 A max	5 V, 3 A max
CONNECTIVITY				
Ethernet	1 Gbit	1 Gbit	1 Gbit	1 Gbit
USB	USB 2.0	USB-C 2.0	USB-C 2.0	USB-C 2.0
Wi-Fi	Requires Wi-Fi dongle	Requires Wi-Fi dongle	Requires Wi-Fi dongle	Requires Wi-Fi dongle
RF INPUTS				
RF input channels	2	2	2	2
Sample rate	125 MS/s	125 MS/s	125 MS/s	125 MS/s
ADC resolution	14 bit	14 bit	14 bit	14 bit
Input impedance	1 MΩ / 10 pF	1 MΩ / 10 pF	1 MΩ / 10 pF	1 MΩ / 10 pF
Full scale voltage range	±1 V (LV) and ±20 V (HV)	±1 V (LV) and ±20 V (HV)	±1 V (LV) and ±20 V (HV)	±1 V (LV) and ±20 V (HV)
Input coupling	DC	DC	DC	DC
Absolute max. input voltage	±6 V (LV) and ±30 V (HV)	±6 V (LV) and ±30 V (HV)	±6 V (LV) and ±30 V (HV)	±6 V (LV) and ±30 V (HV)
Bandwidth	DC - 60 MHz	DC - 60 MHz	DC - 60 MHz	DC - 60 MHz
RF OUTPUTS				
RF output channels	2	2	2	2
Sample rate	125 MS/s	125 MS/s	125 MS/s	125 MS/s
DAC resolution	14 bit	14 bit	14 bit	14 bit
Load impedance	50 Ω	50 Ω / Hi-Z	50 Ω / Hi-Z	50 Ω / Hi-Z
Voltage range	±1 V	±1 V @ 50 Ω and ±2 V @ Hi-Z	±1 V @ 50 Ω and ±2 V @ Hi-Z	±1 V @ 50 Ω and ±2 V @ Hi-Z
Short circuit protection	Yes	Yes	Yes	Yes
Output slew rate	2 V / 10 ns	2 V / 10 ns	2 V / 10 ns	2 V / 10 ns
Bandwidth	DC - 60 MHz	DC - 60 MHz	DC - 60 MHz	DC - 60 MHz
EXTENSION CONNECTOR				
Digital GPIOs	16	16	16	22
Digital voltage levels	3.3 V	3.3 V	3.3 V	3.3 V
High-speed diff. pairs (E3)	N/A	N/A	N/A	8
Analog inputs	4	4	4	4
Analog input voltage range	0 - 3.5 V	0 - 3.5 V	0 - 3.5 V	0 - 3.5 V
Analog input resolution	12 bit	12 bit	12 bit	12 bit
Analog input sample rate	100 kS/s	100 kS/s	100 kS/s	100 kS/s
Analog outputs	4	4	4	4
Analog outputs voltage range	0 - 1.8 V	0 - 1.8 V	0 - 1.8 V	0 - 1.8 V
Analog output resolution	8 bit	8 bit	8 bit	8 bit
Communication interfaces	I2C, SPI, UART, CAN	I2C, SPI, UART, CAN	I2C, SPI, UART, CAN	I2C, SPI, UART, CAN
Available voltages	+5 V, +3V3, -4 V	±5 V, +3V3	±5 V, +3V3	±5 V, +3V3
External ADC clock	Ext. clock models only	No	Yes	Yes
E3 connector	N/A	No	Yes	Yes
SYNCHRONIZATION				
External trigger input	E1 connector (DIO0_P)	E1 connector (DIO0_P)	E1 connector (DIO0_P)	E1 connector (DIO0_P)
Trigger output	E1 connector (DIO0_N)	E1 connector (DIO0_N)	E1 connector (DIO0_N)	E1 connector (DIO0_N)
Daisy chain connection	SATA connectors (up to 500 Mb/s)	N/A	S1 and S2 USB-C connectors (up to 500 Mb/s)	S1 and S2 USB-C connectors (up to 500 Mb/s)
BOOT OPTIONS				
SD card	Yes	Yes	Yes	Yes
QSPI	Not populated	N/A	E3 add-on module	E3 add-on module
eMMC	N/A	N/A	E3 add-on module	E3 add-on module

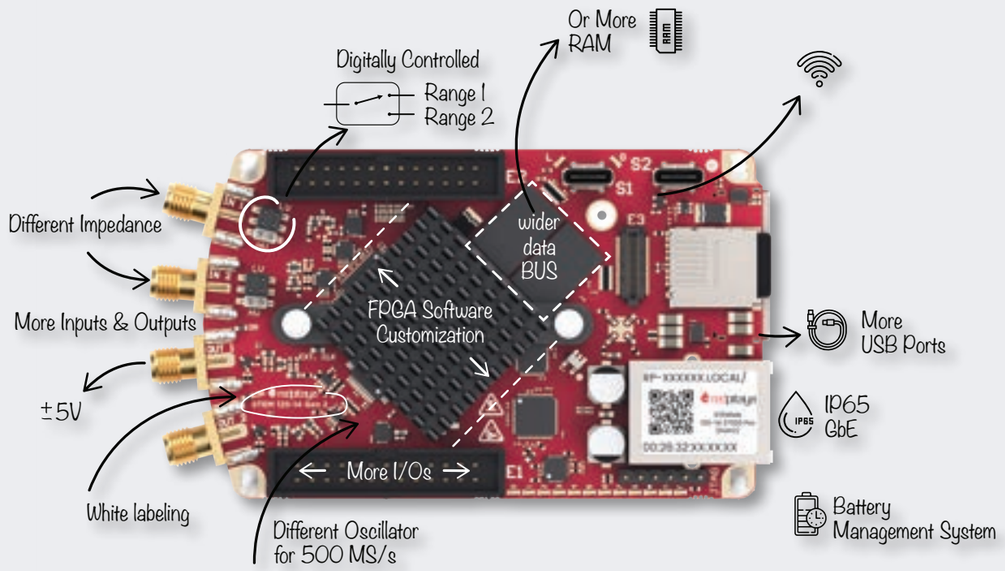
CUSTOMIZATION

Love your Red Pitaya, **BUT IT DOESN'T QUITE MEET YOUR NEEDS?**

We can offer tailored solutions in hardware and software design, rapid prototyping, and product development to meet our clients' specific needs. Our record of success can be seen in collaborations with:

SIEMENS · NASA · BOSCH

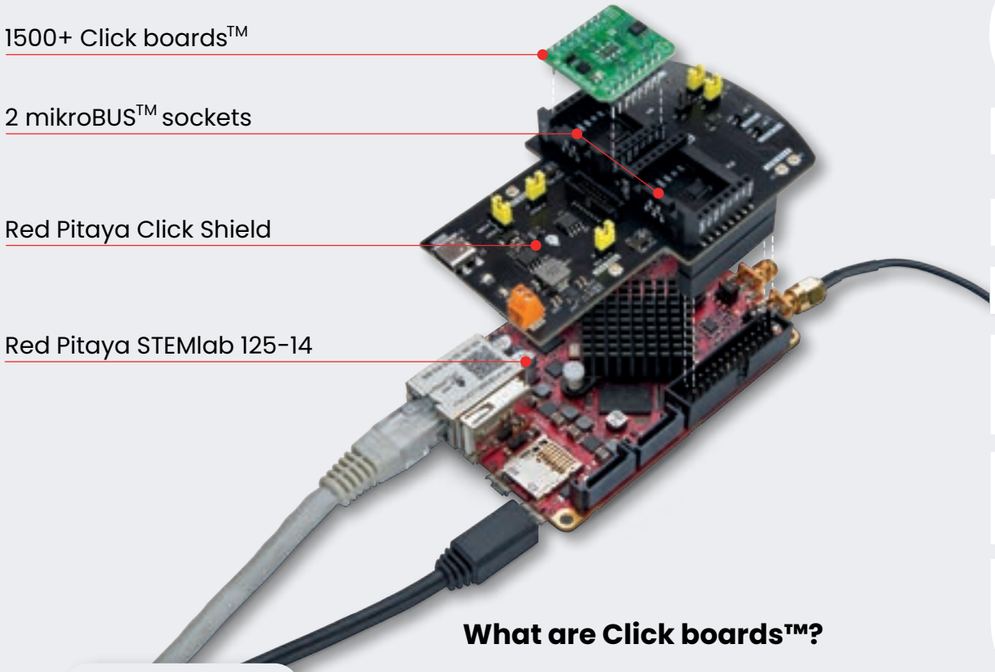
+ many more!



Expand your Red Pitaya **IN +1,500 WAYS!**

Main Features

- Two mikroBUS™ sockets allow interfacing with more than 1,500 MIKROE Click boards™.
- High-performance clock and trigger synchronization between multiple Red Pitaya units or other external clock devices using U.FL patch cables.
- Powering Red Pitaya through an external power supply (12-24 V or via USB-C connector).



MIKROE

Explore MIKROE's library of Click Boards:
// **SCAN THE QR CODE**

What are Click boards™?

Click boards™ by MIKROE are small add-on boards designed to simplify the process of developing electronic projects, by providing a pre-built and tested module with specific functionality, including:

- communication,
- display,
- sensors,
- storage,
- motor control,
- mixed signals, and others.

FIELD

Red Pitaya for **PROTOTYPING, DEVELOPING & TESTING**

Red Pitaya is leading a revolution in the electronics industry, pioneering the move from closed, fixed-functionality instruments to multifunctional, open-source software-defined instruments that can satisfy a broad spectrum of customers in different market segments.

Jet Propulsion Laboratory California Institute of Technology | NASA

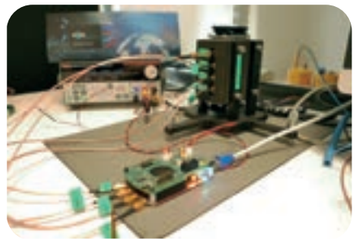
Prototyping Ground-Penetrating Radar for the Mars Science Helicopter

NASA's upcoming helicopter mission to Mars will feature an advanced ultra-wideband, frequency-modulated, continuous-wave ground-penetrating radar system. This cutting-edge radar technology was prototyped utilizing the innovative capabilities of the Red Pitaya SDRlab.

SMG SILICONMICROGRAVITY | Silicon Microgravity (SMG)

Red Pitaya used for development and testing of MEMS

The UK company Silicon Microgravity (SMG) is a designer and producer of advanced sensors and accelerometers with proprietary MEMS resonant technology. SMG runs a wide range of tests for its MEMS in different setups, where reprogrammable units are a major requirement to eliminate the need for redesigning or creating additional custom hardware.



Red Pitaya as an **OEM**

Utilizing Red Pitaya as an OEM has numerous advantages across various industries. Its open-source platform offers a multitude of benefits, including the ability to run custom code, a compact form factor, and affordability.

Red Pitaya device used as an OEM module in an optical frequency reference system

In this project, the Red Pitaya serves as an OEM module within the optical frequency reference system. The Red Pitaya's adaptability and robust features make it an integral component in ensuring precise control and monitoring capabilities within the system.

LONGPATH TECHNOLOGIES | LongPath Technologies

Laser monitoring of methane emissions with Red Pitaya

LongPath Technologies uses a Red Pitaya STEMlab as a main fast feedback controller for frequency comb lasers. These Nobel Prize-winning, long-range laser networks provide the lowest cost detection and quantification of specific emission sources across large areas.

A Full-Stack Teaching Platform for the ECE Curriculum: **FROM CLASSROOM TO CAREER**

Red Pitaya streamlines ECE education by providing a singular, adaptable platform that enables students to focus and deepen their understanding of core engineering principles without the distraction of moving between multiple tools.

SMU | Southern Methodist University (SMU)

Red Pitaya as a Lab Instrument

As a software-defined instrument, a Red Pitaya is the perfect companion to students' first steps in electrical engineering. At Southern Methodist University (SMU) in Dallas, Red Pitaya devices were used in a signal processing course.

Explore SMU's signal processing teaching materials:
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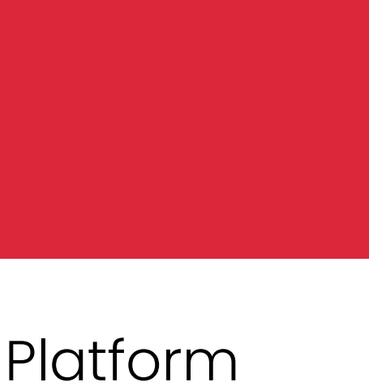

redpitaya | Red Pitaya library

Student Projects with Red Pitaya

Once the students have mastered the basics, they can start using a Red Pitaya device for developing their own projects, ranging from brain computer interfaces to PID controllers.

See our library of student projects:
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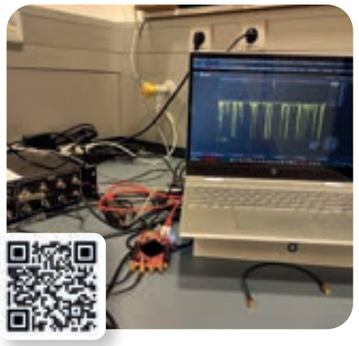

Oklahoma State University

Cutting-Edge Research Powered by Red Pitaya

Red Pitaya is also used in large-scale research, such as this radiation detection project at Oklahoma State University.

Watch our interview with Professor Eric Benton:
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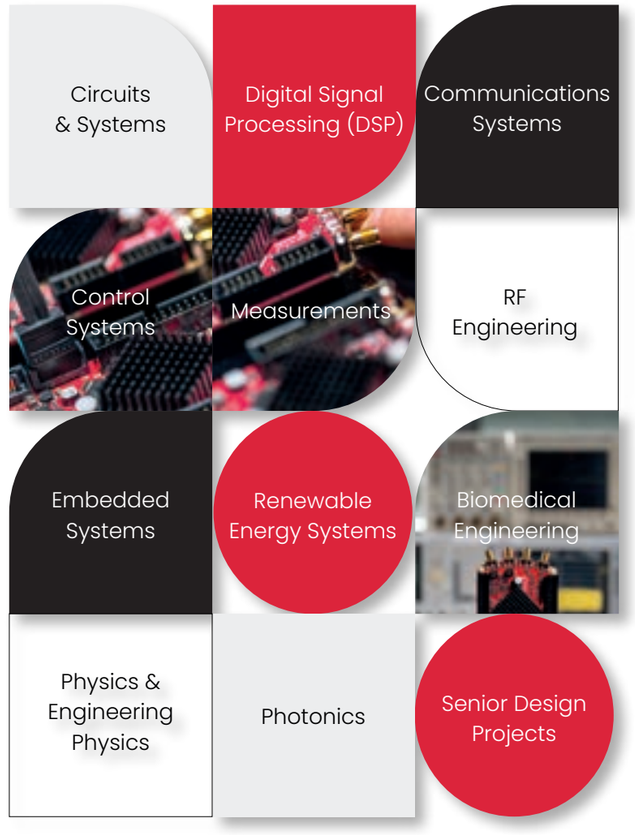
WHICH COURSES **CAN** RED PITAYA **COVER?**

Explore Red Pitaya's teaching materials:
// **SCAN THE QR CODE**



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Nominations & **AWARDS**

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We're proud to be recognised with multiple awards in 2025 — including the prestigious **Learning Technologies Award** and our Gold Champion title at the **Engineering Matters Awards**, celebrating our commitment to innovation and sustainability.

Six reasons to **BUY RED PITAYA**

Power of Open Source

Unlock endless customization with our fully open-source platform, encouraging user-driven innovation to meet any engineering need.

Integrated Toolset

Elevate efficiency with our sleek device, engineered to replace a multitude of bulky lab instruments, freeing up valuable workspace.

Top-Tier Processing

Experience the power of Xilinx Zynq SoC with our devices, blending an FPGA and ARM processor for unmatched real-time processing and flexibility.

Affordable Excellence

Enjoy advanced testing and prototyping without hidden fees or licenses. Our cost-efficient solution lowers financial barriers, enabling broader innovation.

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Red Pitaya replaces a vast range of test & measurement instruments & can be controlled by LabVIEW, MATLAB, Python or programmed to your own needs.

Accessible Remote Control

All Red Pitaya products are IoT devices that can perform remote and distributed measurements and provide real-time data.

Great minds in different segments **TRUST RED PITAYA PRODUCTS**

1. Industry

Companies in the automotive, aerospace, telecommunications and medical fields use Red Pitaya as a reliable OEM component for a variety of RF applications.

"Red Pitaya has been critical in transitioning our system from a proof-of-concept, laboratory instrument to a field-hardened industrial tool."

Robert Wright - Co-Founder and VP Engineering at LongPath Technologies

2. Academia

Red Pitaya helps professors teach more efficiently and effectively, and students learn with greater ease. Learning FPGA programming and the basics of electronics is now more intuitive and affordable than ever.

"We have been making extensive use of Red Pitaya, which has become an essential part of our activities as we conduct educational activities on radiation measurement targeted at middle and high school students. The range of research made possible by fast data collection is broad, and in this respect, Red Pitaya has become an important and easily accessible tool for middle and high school students."

Kazuo Tanaka - CEO at Accel Kitchen LLC, Associate Professor at Waseda University

3. Research

Red Pitaya is an essential component of many scientific research projects in the fields of physics, communication, materials and bioscience. Use Red Pitaya to speed up your experimental setup and get faster results.

»We are very happy with STEMlab 125-14's flexibility and ease of use. At Danish Technical University these boards have been instrumental in our DASQ-1 quantum computer project where we used them for stabilizing optical paths and photon arrival time tagging.«

Axel Bogdan Bregnsbo - Research Engineer at Technical University of Denmark

4. Radio amateurs & makers

Red Pitaya provides a great price/performance solution to build your own SDR transceiver or other DIY projects.

"Thanks to Pavel Demin's free SDR Receiver App, the Red Pitaya can be used by both CW Skimmer Server and RTTY Skimmer Server to monitor about 180 kHZ on each of EIGHT different radio bands, simultaneously. I'm not aware of any other SDR currently on the market that can do this so well at such a low cost."

Bob Wilson - N6TV

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