

PC Engines

apu2 series system board

# Table of contents

CE declaration of conformity	3
Recycling / disposal	3
Federal Communications Commission Statement	4
Introduction / Features	5
Heat spreader assembly	5
Getting started...	6
Setup options	6
Memtest	7
BIOS update	7
CoreBoot source code	7
Connectors	8
Schematics	9
Hardware limitations	9
GPIO	9
Operating system compatibility	10
FreeBSD	10
FreeDOS	10
Linux	10
NetBSD	10
OpenBSD	10
OPNsense	10
pfSense® software	10

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PC Engines GmbH  
[www.pcengines.ch](http://www.pcengines.ch)

# CE declaration of conformity

**Supplier's Name:** PC Engines GmbH  
**Supplier's Address:** Flughofstrasse 58, 8152 Glattbrugg, Switzerland

**declares, that the product**

**Product name and model:** apu2b2, apu2b4, apu2c0, apu2c2, apu2c4

**conforms to the following Product Specifications and Regulations:**

**EMC (EN 301 489-1 V1.9.2 2011-09):**

- EN 55022:2010/AC:2011 Class B (emissions)
- EN 61000-4-2:2009 (ESD)
- EN 61000-4-3:2006/A1:2008/A2:2010 (radiated immunity)
- EN 61000-4-4:2012 (electrical fast transient / burst immunity)
- EN 61000-4-5:2014 (surge immunity)
- EN 61000-4-6:2014 (conducted immunity)

**RoHS:**

EN 50581:2012

The product herewith complies with the requirements of the EMC directive 2014/30/EU, the RoHS directive 2011/65/EU and carries the CE marking accordingly.

*P. Dornier*

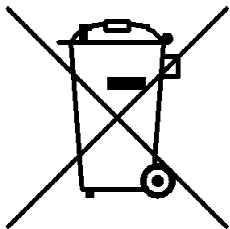
Pascal Dornier

President

Glattbrugg, October 12, 2017

Test reports available on request. Please note that further compliance testing at the system level may be required for CE mark when other modules such as wireless cards are added.

## Recycling / disposal



Do not discard electronic products in household trash! All waste electronics equipment should be recycled according to local regulations.

**Information for the recycler:**

Remove the LR44 alkaline battery for separate recycling. Our enclosures are made of aluminium.

## Federal Communications Commission Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio energy. If this equipment is not installed and used in accordance with the manufacturer's instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This board is designed for installation in a shielded enclosure (metal or plastic with conductive coating). Shielded cables may be required on LAN and serial ports to assure compliance with FCC regulations.

A copy of the test report will be provided on request.

Note: apu has been tested as a CPU board, installed in an enclosure, with the top cover removed. No further testing should be required if the board is used with other FCC tested modular components. Please see <http://www.fcc.gov/oet/> for more details. The responsible party for FCC is the importer.

## Introduction / Features

PC Engines apu boards are small form factor system boards optimized for wireless routing and network security applications.

CPU	AMD G series GX-412TC, 1 GHz quad core (Jaguar core) with 64 bit support, AES-NI, 32K data + 32K instruction cache per core, 2MB shared L2 cache
DRAM	2 or 4 GB DDR3-1333 DRAM
Storage	Boot from SD card (built-in adapter, connected through USB), USB or m-SATA SSD. 1 SATA data + power connector.
Power	12V DC, 2.5 mm center pin, center positive. About 6 to 10W depending on CPU load. Recommend 12V adapter rated for at least 1.5A to provide margin for peripherals.
Expansion	2 miniPCI express (one with SIM socket for 3G modem), LPC bus, GPIO header, optional I2C bus, COM2 (3.3V RXD/TXD).
Connectivity	3 Gigabit Ethernet (Intel i210AT / i211AT), 1 DB9 serial port (console).
Firmware	CoreBoot open source system BIOS with support for iPXE and USB boot.
Form factor	6"x6" (152.4 x 152.4 mm), fits in our case1d2*u enclosures.
Cooling	Conductive cooling from the CPU to the enclosure.

## Heat spreader assembly

The apu CPU is passively cooled by heat conduction to the enclosure. This requires correct installation of a heat spreader.

**The board should not be operated without CPU cooling except for brief bench tests.**

The included heat spreaders are designed for our enclosures. Third party enclosures should work if they are made from aluminium, and have a board standoff height of 5 mm. If in doubt, please contact us. Based on our measurements, at full load the CPU runs a few degrees cooler in the black (case1d2blku) or red (case1d2redu) enclosures, compared to the plain anodized enclosure (case1d2u).

Photos for this assembly procedure can be found at [www.pceingines.ch/apucool.htm](http://www.pceingines.ch/apucool.htm) .

- Remove DB9 hex nuts using a suitable tool (such as our hexbit tool, or a simple plier).
- Using a small x-acto knife or similar, peel transparent backing foil from the small blue heat conductive pad. Apply to the CPU. Then peel the blue cover foil from the heat conductive pad.
- Place the alu heat spreader (blank side down) over the CPU. Make sure to avoid conflict with nearby through hole components. Peel the cover foil.
- "Bottoms up" - hold the enclosure base upside down, feed the board DB9 and LAN connectors through the openings. Lightly press board and enclosure base together to stick the heat spreader in place.
- Turn around and carefully press down around CPU and heat sink to get good contact between enclosure and heat spreader. Then insert screws and hex nuts.

Please do not disassemble the unit needlessly, the thermal conductive pads are easily damaged. Replacement blue pads (free) or complete heat spreader kits (nominal charge + shipping cost) are available from us on request.

## Getting started...

- Please install heat spreader as described in the prior section.
- Insert a boot device (SD card, mSATA SSD, USB stick, or PXE through LAN).
- Connect serial port to a PC through null modem cable (RXD / TXD crossed over). Set terminal emulator to 115200 8N1.
- Connect Ethernet as needed.
- Connect a 12V DC power supply to the DC jack. Power supply should be able to supply at least 18W for some margin. To avoid arcing, please plug in the DC jack first, then plug the adapter into mains.

The board should now power on. All three LEDs will light during BIOS POST, then the system will try to boot. You should see BIOS messages on the serial console. Press F10 for boot device selection. For example:

```
PCengines Press F10 key now for boot menu:
Select boot device:
1. SD card SD04G 3796MiB
2. Payload [memtest]
3. Payload [setup]
```

## Setup options

To set up the boot sequence and other options, press F10 for boot device selection, then select Payload [setup].

```
=====
Type lower case letter to move device to top
=====
boot devices

  a SD Card
  b USB 1
  c USB 2
  d mSATA
  e SATA 2
  f SATA 3
  g NETWORK / PXE

=====
Type upper case letter to invoke action
=====
  R Restore boot order defaults
  N Network/PXE boot - Currently Enabled
  S Serial console - Currently Enabled
  E Exit setup with save
  X Exit setup without save
```

The lower case letters will change the boot sequence, pull the selected device to the top of the list.

R toggles serial console enable. Push the switch S1 during startup to get into setup when the serial console is disabled.

## **Memtest**

To start, press F10 for boot device selection, then select Payload [memtest].  
(current builds do not react to console inputs)

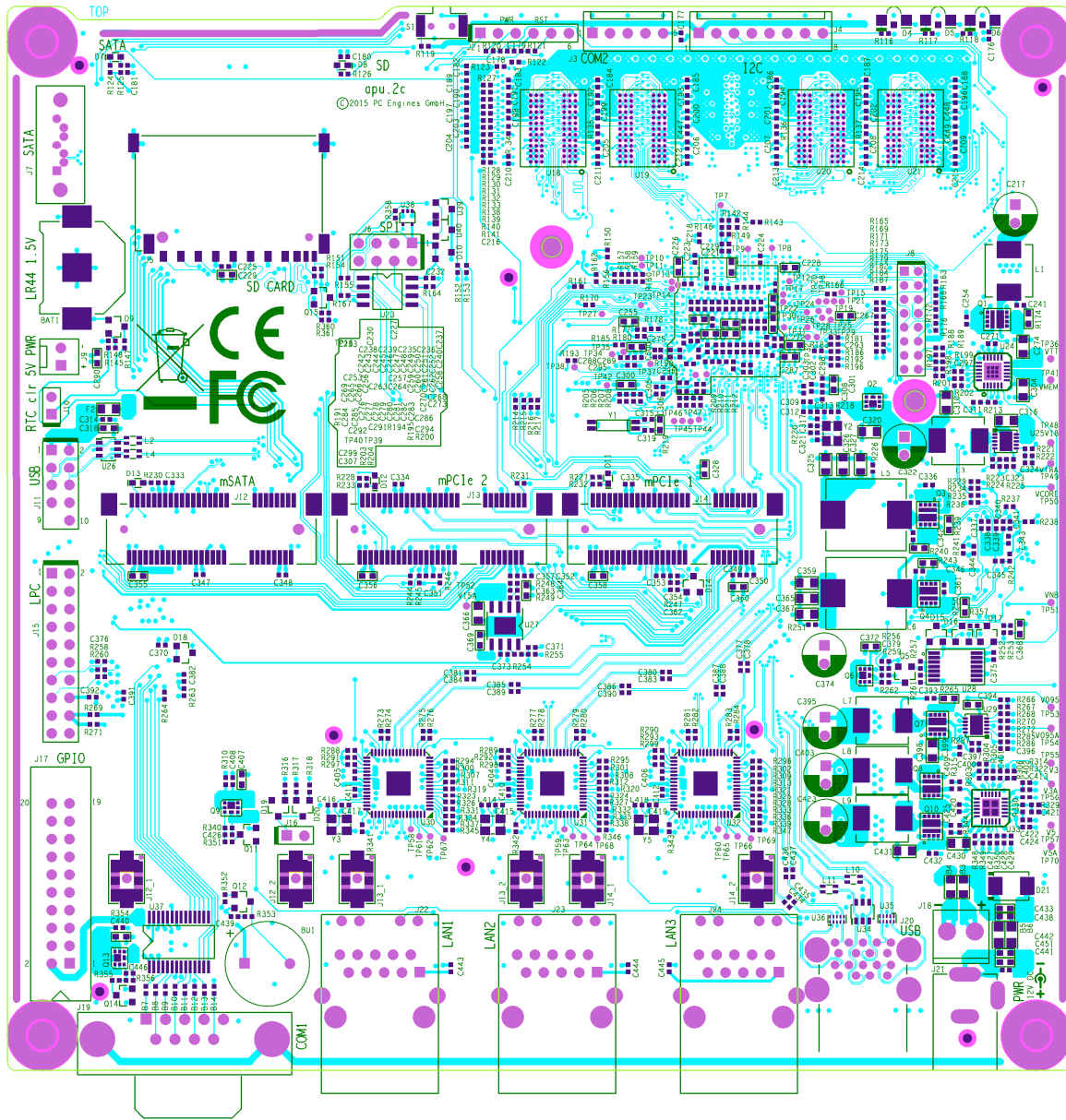
## **BIOS update**

Please see [www.pcengines.ch/howto.php](http://www.pcengines.ch/howto.php) .

## **CoreBoot source code**

The CoreBoot firmware is licensed under the GPL. To obtain the source code and a Voyage Linux image with the tool chain needed to compile it, please contact [support@pcengines.ch](mailto:support@pcengines.ch) .

# Connectors



BAT1 battery	LR44 1.5V alkaline battery for RTC / CMOS
J1 SIM	(bottom side) – SIM socket for 3G modem installed in miniPCIe J13.
J2 power / reset	<p>Pins 1-2 = SPI write protect (requires additional software support to configure SPI flash)</p> <p>Pins 2-3 = power button</p> <p>Pins 4-5 = reset button</p> <p>Pins 5-6 = enable NCT5104D watchdog reset (requires additional software support)</p>
J3 COM2	3.3V serial port (RXD / TXD only).



(J4 I2C / LED)	(optional expansion, see schematic for pinout)
J5 SD card	SD card interface, driven by AMD SOC, use sdhci driver.
J6 SPI	SPI header for debricking. Do not connect pins 7 / 8 for Dediprogram use.
J7 SATA	For SATA devices.
(J8 JTAG)	Debug only, not populated.
J9 SATA power	5V power for SATA devices.
J10 CMOS reset	Short these pins while power is off to clear RTC / CMOS RAM. Don't leave jumper permanently as this would drain the battery.
J11 USB	Internal USB (2 x USB 2.0)
J12 m-SATA	For m-SATA SSD only, not for miniPCI express devices.
J13 miniPCI express	For miniPCIe cards, including 3G modems (SIM socket J1 on bottom side)
J14 miniPCI express	For miniPCIe cards.
J15 LPC	LPC header for expansion.
J17 GPIO	General purpose I/O pins + extra serial ports.
(J18 internal power)	Optional power header, designed for 0.156" pitch header (Digi-Key part A1971-ND).
J19 COM1	Serial port with full handshake signals.
J20 USB	External USB (2 x USB 3.0)
J21 Power	DC jack (2.5 mm center pin, center positive).
J22 LAN1	GigE port. Left LED (green) indicates activity, right LED (amber) is turned on when the connection is Gigabit.
J23 LAN2	GigE port
J24 LAN3	GigE port
(J25 SIM)	(bottom side, optional) – SIM socket for 3G modem installed in miniPCIe J14.

## Schematics

Can be found on our web site.

## Hardware limitations

This board does not support power over Ethernet.

## GPIO

The following signals are driven by the AMD FCH south bridge function:

Pushbutton switch S1 = G32

LED1 = G57, LED 2 = G58, LED 3 = G59

GPIO pins on header J17 are driven by the Nuvoton NCT5104D I/O controller. Data sheet and

sample code available on request.

## Operating system compatibility

Please keep in mind that apu boards do not include a keyboard controller. Some boot loaders may hang and need to be modified.

### FreeBSD

Recommend versions 10 and later.

### FreeDOS

Tested ok, booting from SD card or USB stick.

CoreBoot is limited to two active USB storage devices, and does not react to kindly to hot plug events.

### Linux

Please contact [support@pcengines.ch](mailto:support@pcengines.ch) for support if necessary. We provide sample images for tinyCore Linux at [www.pcengines.ch/tinycore.htm](http://www.pcengines.ch/tinycore.htm). To access the thermal sensor under Voyage Linux:

```
# apt-get install lm-sensors
```

### NetBSD

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### OpenBSD

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### OPNsense

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### pfSense® software

Wle200nx is supported by pfSense software version 2.2 and later. Wle600vx is NOT supported.

Simplified install instructions:

Prepare a USB stick with TinyCore Linux (see above).

Copy the pfSense software image (amd64 nanobsd with serial console) to the FAT partition of the TinyCore USB stick

Boot the apu board with the TinyCore USB stick

Write the image to the mSATA or SD card:

```
fdisk -l          -> look up the destination drive ID (/dev/sdX below)
gzip -dc pfSense-2.X-RELEASE-Xg-amd64-nanobsd.img.gz | pv | dd of=/dev/sdX bs=10M
```

Remove USB stick and reboot, the system should now start.