# PC Engines

# ALIX.2 / ALIX.3 series system boards

PC Engines GmbH
www.pcengines.ch

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# 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 are required on LAN and serial ports to assure compliance with FCC regulations.

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

# CE Declaration of Conformity

We, PC Engines GmbH, declare that ALIX.2 and ALIX.3 series boards, when installed in PC Engines metal enclosures. (case1c1 / case1c2 / box2c), are in conformance with:

- EN 61000-6-3 (2005)                          (emissions, residential and industrial)

- EN 61000-6-2                                 (ESD, susceptibility, residential and industrial)

The unit under test is in conformity with the standards mentioned above. A copy of the test report will be provided on request.

# Compliance information

For FCC, ALIX 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.

Testing for CE mark must be done at the level of the complete product, possibly including the wireless cards. Please contact PC Engines for assistance and documentation.

For satisfactory resistance to electrostatic discharge events (ESD), the ALIX board should be grounded (e.g. through the mounting holes, or the serial port connector). The USB port on ALIX.2B / ALIX.3B boards is sensitive to ESD events, spurious overcurrent events may be detected in this version.

# Recycling / disposal
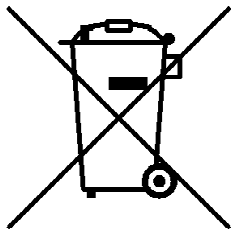


Do not discard electronic products in household trash!

All waste electronics equipment should be recycled according to local regulations.

**Information for the recycler:**

Cut off Lithium battery, if present, for separate recycling.

PC Engines enclosures are made of aluminium.

# Introduction / features

ALIX.2 and ALIX.3 are small form factor system boards optimized for wireless routing and network security applications.

- AMD Geode LX CPU, 433 Mhz (LX700) or 500 MHz (LX800) 5x86 CPU,
- 256 KB cache (64K data + 64K instruction + 128K L2)
- 1 to 3 Ethernet channels (Via VT6105M, 10 / 100 Mbit/s)
- 1 or 2 miniPCI sockets for 802.11 wireless cards and other expansion
- 128 or 256 MB DDR SDRAM, 64 bit wide for high memory bandwidth
- 512 KB flash for PC Engines tinyBIOS
- CompactFlash + optional 44 pin IDE header for user's operating system and application
- 7 to 18V (absolute maximum) DC supply through DC jack or passive power over Ethernet
- 1 serial port (DB9 male)
- 2 USB 2.0 ports (optional)
- Header for LPC bus (use for flash recovery or I/O expansion)

# OEM options

The following options can be configured for larger orders:

- DRAM size (128 MB, 256 MB)
- CPU speed (LX700 / LX800 / LX900)
- Delete I/O not required by customer
- CMOS level serial port (RXD / TXD only)
- Optional header for I2C bus
- Optional buzzer for "beeps"
- Optional RTC battery
- ALIX.3: optional AC97 audio codec (headphone + mic)
- ALIX.3: optional VGA video
- ALIX3: optional pushbutton switch
- PC Engines tinyBIOS

# ALIX.2 series

| | |
|---|---|
| Configuration | 2 LAN / 2 miniPCI, or 3 LAN / 1 miniPCI |
| Power supply | 7 to 20V DC, about 3 to 4W at Linux idle, peak about 6W without miniPCI cards and USB devices. Suggest a 18V / 15W supply. Center pin = positive, sleeve = ground, 2.1 mm diameter. |
| Temperature range | 0 to 50°C. |
| Dimensions | 6 x 6" (152.4 x 152.4 mm) |
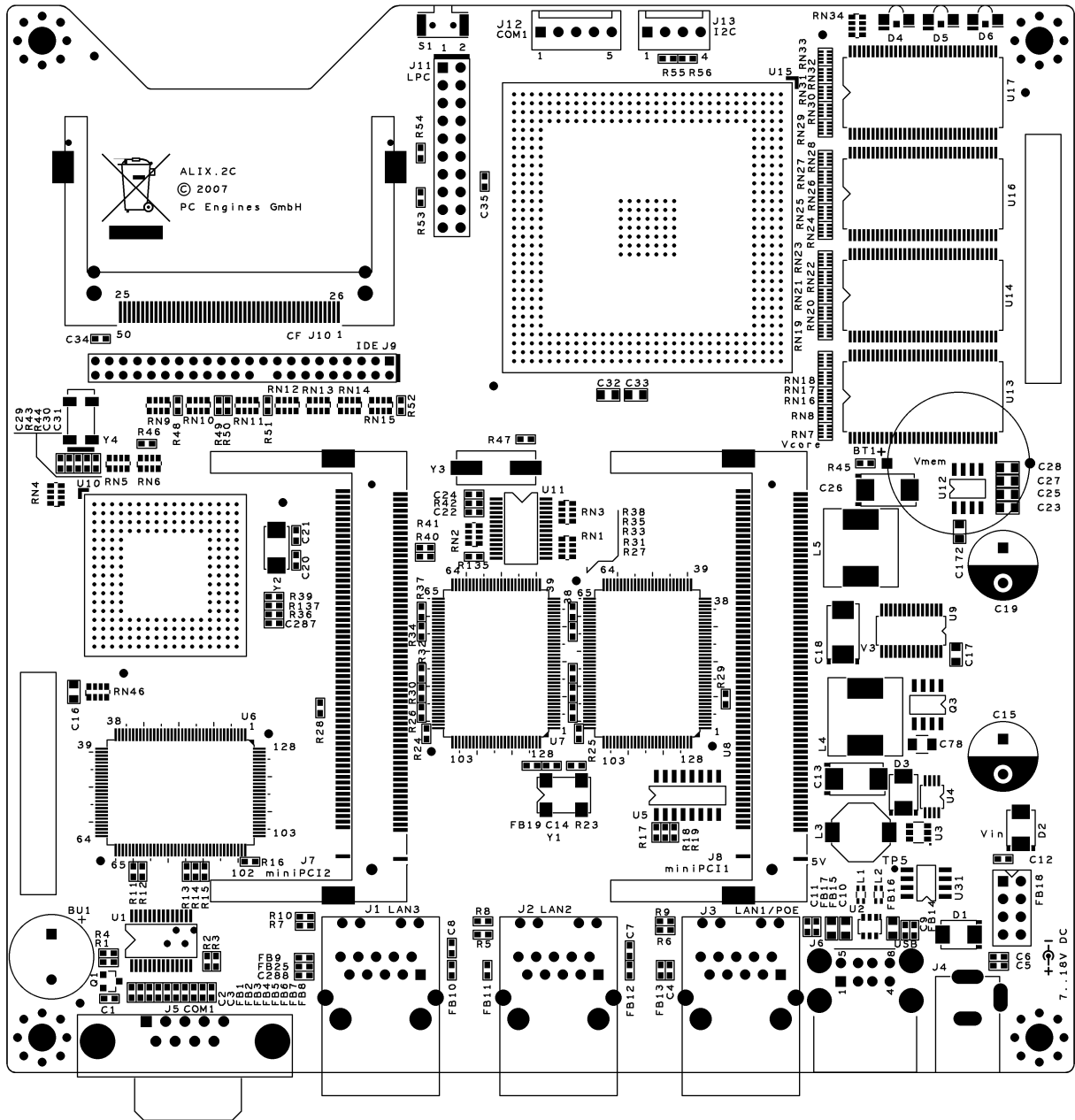
# ALIX.3 series

| | |
|---|---|
| Configuration | 1 LAN / 2 miniPCI |
| Power supply | 7 to 20V DC, about 2.5 to 3.5W at Linux idle, peak about 5W without miniPCI cards and USB devices. Suggest a 18V / 15W supply. Center pin = positive, sleeve = ground, 2.1 mm diameter. |
| Temperature range | 0 to 50°C. |
| Dimensions | 100 x 160 mm |
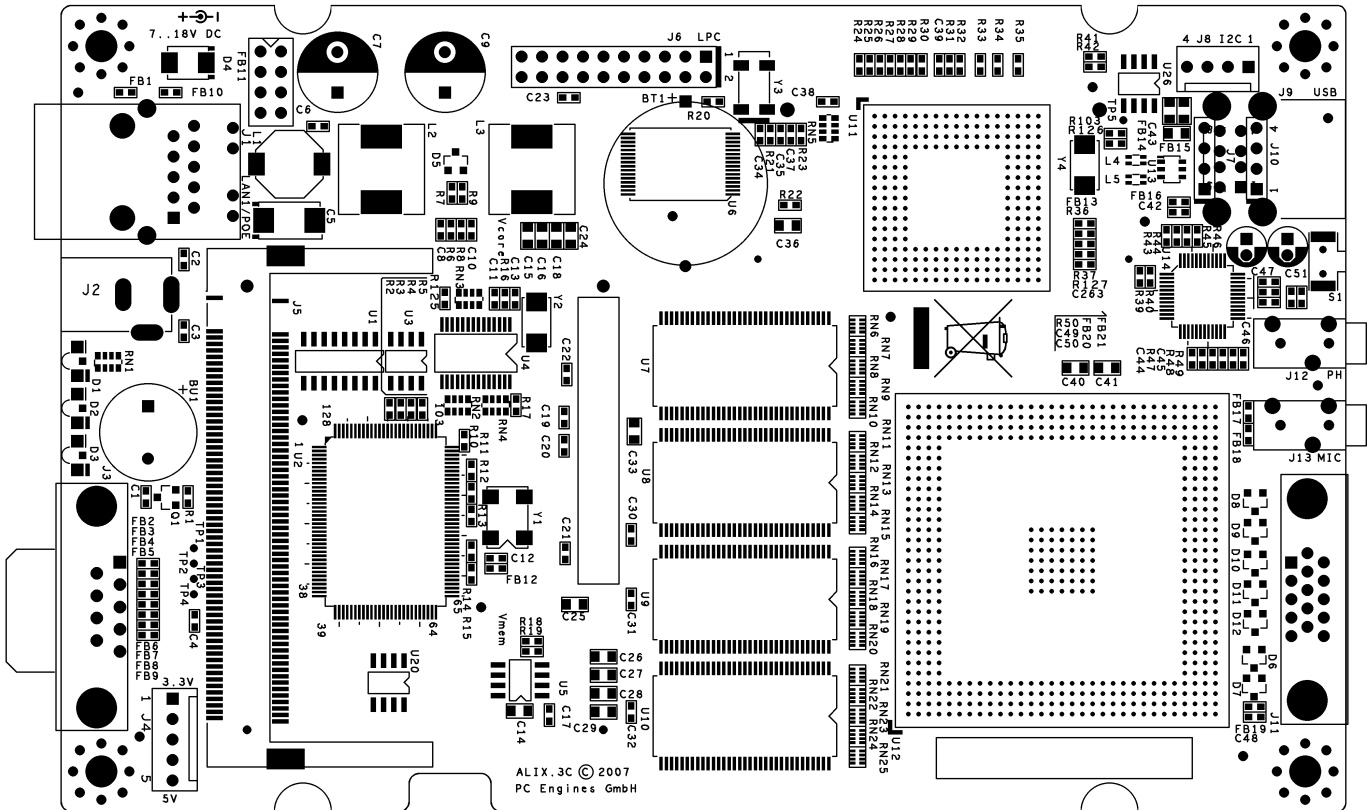
# Getting started…

- Install a bootable CF card. Hot swap of CF cards is not supported!

- Connect serial port to a PC through null modem cable (RXD / TXD crossed over). Set terminal emulator to 38400 8N1, flow control = none or xon-xoff.

- Connect Ethernet as needed.

- Connect a 18V DC power supply to the DC jack. Power supply should be able to supply at least 12W 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, and turn off two of the LEDs.

You should see tinyBIOS startup messages, memory size, CF disk geometry on the serial console.

# Setup options

To enter setup, type S during the memory test. You should see something like the following:

< Not yet functional in the BIOS >

# Operating system compatibility

Please keep in mind that ALIX.2 and ALIX.3 boards do not include a keyboard controller. Some boot loaders may hang and need to be modified.

For best performance, include support for AMD Geode LX / CS5536, and use a current driver for the Via VT6105M LAN controller (supports TCP/IP checksumming, byte aligned transmit buffers).

## FreeBSD

Current versions of FreeBSD may panic due to issues in the EHCI configuration. Disable EHCI driver if problems appear.

## FreeDOS, MS-DOS 5.0

Tested ok, booting from CF card.

## Linux

Try www.imedialinux.com for a kernel preconfigured with Geode LX drivers.
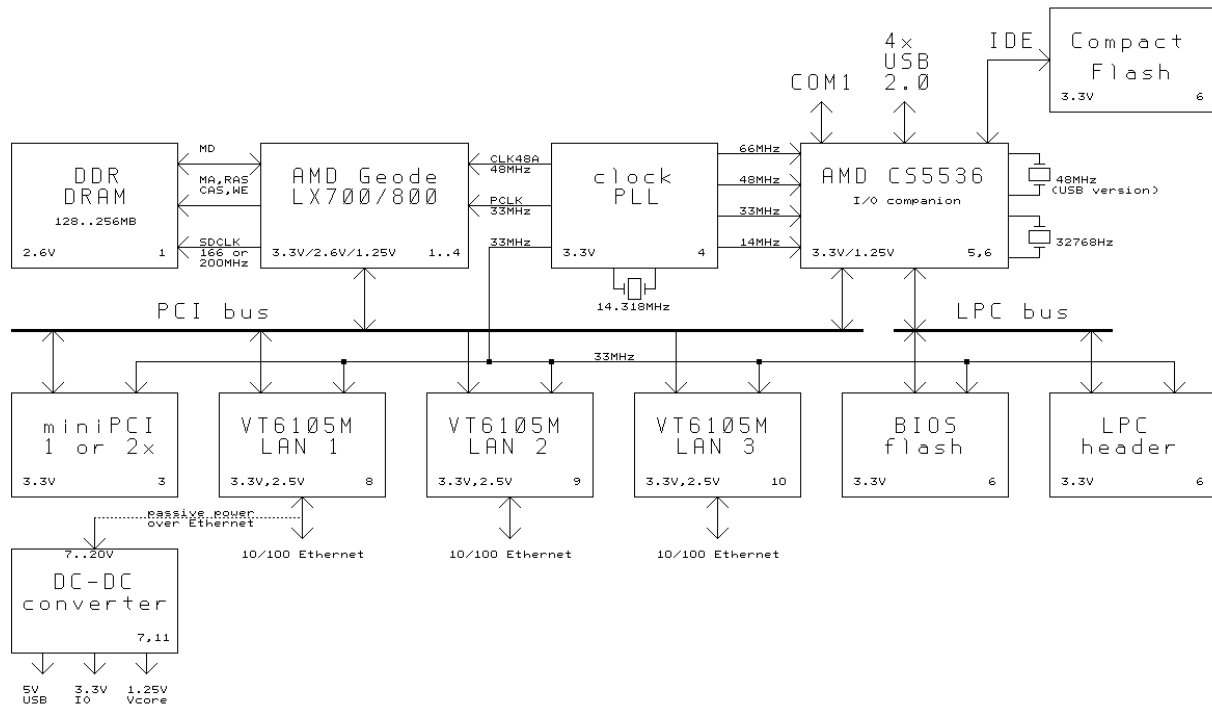
## NetBSD

Not yet tested.

## OpenBSD

OpenBSD 4.0-stable and later versions should support AMD Geode LX.

# ALIX block diagram

Schematics will be made available to qualified customers.

# ALIX connector pinouts

References refer to ALIX.2 / ALIX.3.

**J5/J3                            COM1 serial port**

The standard PC pinout is used. To connect to a PC, use a null modem or "Laplink" cable. Due to limitations of the AMD CS5536 companion chip, handshake signals are not available.

| 1 | DCD | data carrier detect (input) | - not available on CS5536 |
|---|-----|------------------------------|----------------------------|
| 2 | RXD# | receive data (input) | |
| 3 | TXD# | transmit data (output) | |
| 4 | DTR | data terminal ready (output) | - driven active |
| 5 | GND | ground | |
| 6 | DSR | data set ready (input) | - not available on CS5536 |
| 7 | RTS | ready to send (output) | - driven active |
| 8 | CTS | clear to send (input) | - not available on CS5536 |
| 9 | RI | ring indicator (input) | - not available on CS5536 |

**J12 / J4                        COM1 serial port (build option)**

As an option, the board can be configured with a 4 or 5 pin header with 3.3V CMOS signal levels instead of the normal RS-232 serial port.

| 1 | V3 | 3.3V supply |
|---|-----|-------------|
| 2 | TXD | transmit data (output) |
| 3 | RXD | receive data (input) |
| 4 | GND | ground |
| 5 | VCC | 5V supply |

**J3/J1                           Ethernet port 1**

RJ45 connectors with integrated magnetics are used. This port implements a passive power over Ethernet scheme over the two unused pairs. Do not exceed 20V as the TVS protection diode may start clamping above this voltage.

| 1 | TX+ | transmit positive |
|---|-----|-------------------|
| 2 | TX- | transmit negative |
| 3 | RX+ | receive positive |
| 4 | VIN | power supply (nominal 7 to 20V) |
| 5 | VIN | " |
| 6 | RX- | receive negative |
| 7 | GND | power return |
| 8 | GND | " |

**J1, J2 / -                      Ethernet ports 2, 3**

RJ45 connectors with integrated magnetics are used. These ports do NOT support power over Ethernet. Same pinout as above, but pins 4,5 and 7,8 are not connected.

### J6/J9                   USB jack (build option)

Dual USB 2.0 connections:

| 1 | VCC | switched +5V supply |
|---|------|-----|
| 2 | DATA4- | negative data |
| 3 | DATA4+ | positive data |
| 4 | GND | ground |
| 5 | VCC | switched +5V supply |
| 6 | DATA3- | negative data |
| 7 | DATA3+ | positive data |
| 8 | GND | ground |

### J4/J2                   DC power jack

This is a generic DC jack connector with a 2.1mm center pin. Recommended input voltage is +18V.

| center | VIN | Positive input voltage |
|--------|-----|-----|
| sleeve | GND | Ground |

### J7, J8 / J5, J14       miniPCI socket

These sockets implement the miniPCI interface. Please see schematic for pinout.

### J9 / -                   IDE header (build option)

| 1 | HDRST# | IDE reset |
|----|---------|-----|
| 2 | GND | ground |
| 3 | HDD7 | IDE data 7 |
| 4 | HDD8 | IDE data 8 |
| 5 | HDD6 | IDE data 6 |
| 6 | HDD9 | IDE data 9 |
| 7 | HDD5 | IDE data 5 |
| 8 | HDD10 | IDE data 10 |
| 9 | HDD4 | IDE data 4 |
| 10 | HDD11 | IDE data 11 |
| 11 | HDD3 | IDE data 3 |
| 12 | HDD12 | IDE data 12 |
| 13 | HDD2 | IDE data 2 |
| 14 | HDD13 | IDE data 13 |
| 15 | HDD1 | IDE data 1 |
| 16 | HDD14 | IDE data 14 |
| 17 | HDD0 | IDE data 0 |
| 18 | HDD15 | IDE data 15 |
| 19 | GND | ground |
| 20 | key | key pin (missing) |
| 21 | HDRQ | IDE DMA request |
| 22 | GND | ground |
| 23 | HDIOW# | IDE I/O write |
| 24 | GND | ground |
| 25 | HDIOR# | IDE I/O read |
| 26 | GND | ground |
| 27 | HDIORDY | IDE I/O ready |
| 28 | CSEL | cable select (pull down) |

| 29 | HDACK# | IDE DMA acknowledge |
| --- | --- | --- |
| 30 | GND | ground |
| 31 | HDIRQ | IDE interrupt |
| 32 | nc | no connect |
| 33 | HDA1 | IDE address 1 |
| 34 | HDPDIA# | IDE diagnostic, 80 pin cable ID |
| 35 | HDA0 | IDE address 0 |
| 36 | HDA2 | IDE address 2 |
| 37 | HDCS0# | IDE chip select 0 |
| 38 | HDCS1# | IDE chip select 1 |
| 39 | HDLED# | IDE led output |
| 40 | GND | ground |
| 41 | VCC | 5V power |
| 42 | VCC | 5V power |
| 43 | GND | ground |
| 44 | GND | ground |

## J10 / J15        CompactFlash

The CompactFlash card is used in True IDE mode. Hot insertion is not supported – please power off the unit before inserting a CF card.

| 1 | GND | ground |
| --- | --- | --- |
| 2 | D3 | IDE data |
| 3 | D4 | IDE data |
| 4 | D5 | IDE data |
| 5 | D6 | IDE data |
| 6 | D7 | IDE data |
| 7 | CS0# | IDE decode (1F0..1F7) |
| 8 | A10 | ground |
| 9 | ATASEL# | ground to select true IDE mode |
| 10 | A9 | ground |
| 11 | A8 | ground |
| 12 | A7 | ground |
| 13 | VCC | +3.3V power supply |
| 14 | A6 | ground |
| 15 | A5 | ground |
| 16 | A4 | ground |
| 17 | A3 | ground |
| 18 | A2 | IDE address |
| 19 | A1 | IDE address |
| 20 | A0 | IDE address |
| 21 | D0 | IDE data |
| 22 | D1 | IDE data |
| 23 | D2 | IDE data |
| 24 | IO16# | 16 bit decode, not connected |
| 25 | CD2# | card detect, not connected |
| 26 | CD1# | card detect. not connected |
| 27 | D11 | IDE data |
| 28 | D12 | IDE data |
| 29 | D13 | IDE data |
| 30 | D14 | IDE data |

| 31 | D15 | IDE data |
|----|-----|----------|
| 32 | CS1# | IDE decode (3F6..3F7) |
| 33 | VS1# | not connected |
| 34 | IOR# | IDE read strobe |
| 35 | IOW# | IDE write strobe |
| 36 | WE# | connected to +3.3V |
| 37 | IRQ | IDE interrupt |
| 38 | VCC | +3.3V power supply |
| 39 | CSEL# | cable select, ground = master |
| 40 | VS2# | not connected |
| 41 | RESET# | IDE reset, active low |
| 42 | IORDY | IDE ready |
| 43 | INPACK# | IDE DMA request |
| 44 | REG# | IDE DMA acknowledge |
| 45 | DASP# | pulled up |
| 46 | PDIAG# | pulled up |
| 47 | D8 | IDE data |
| 48 | D9 | IDE data |
| 49 | D10 | IDE data |
| 50 | GND | ground |

The CompactFlash specification can be found at www.compactflash.org.

## J11 / J6          LPC expansion

The LPC port is used in the factory to connect an alternate flash BIOS to start the board when the on-board flash is corrupted or blank. Use PC Engines adapter LPC.1A for this purpose if needed.

The LCP port can also be used to connect a super I/O device. Unlike SC1100 based WRAP boards, this port cannot be reprogrammed as GPIO pins.

| 1 | LCLK0 | LPC clock (33 MHz) |
|----|-------|---------------------|
| 2 | GND | ground |
| 3 | LAD0 | LPC data 0 |
| 4 | GND | ground |
| 5 | LAD1 | LPC data 1 |
| 6 | GND | ground |
| 7 | LAD2 | LPC data 2 |
| 8 | GND | ground |
| 9 | LAD3 | LPC data 3 |
| 10 | GND | ground |
| 11 | LFRAME# | LPC frame |
| 12 | GND | ground |
| 13 | PCIRST# | reset (active low) |
| 14 | CLK48 | super I/O clock (48 MHz) |
| 15 | ISP | high to use LPC flash, low to use on-board flash, pulled low by resistor |
| 16 | VCC | +5V supply |
| 17 | GND | ground |
| 18 | V3 | +3.3V supply |
| 19 | SERIRQ | serial interrupt |
| 20 | LDRQ# | LPC DMA request |

**J13 / J8**  I2C bus (build option)

This optional header can be used to connect user specific hardware, e.g. a front panel microcontroller, or for a licensing dongle.

| 1 | +3.3V | power supply |
| 2 | SMB_SCL | I2C clock |
| 3 | SMB_SDA | I2C data |
| 4 | GND | ground |

**- / J12**  Headphone out (build option)

**- / J13**  Microphone in (build option)

**- / J11**  VGA (build option)

| 1 | VGAR | VGA red |
| 2 | VGAG | VGA green |
| 3 | VGAB | VGA blue |
| 4 | nc | no connect |
| 5 | GND | ground |
| 6 | GND | ground |
| 7 | GND | ground |
| 8 | GND | ground |
| 9 | USBVCC | +5V supply (fused) |
| 10 | GND | ground |
| 11 | nc | no connect |
| 12 | DDCDAT | DDC data |
| 13 | HS | horizontal sync |
| 14 | VS | vertical sync |
| 15 | DDCCLK | DDC clock |

**BAT1**  RTC battery (build option)

Soldered CR2032 Lithium battery.

**BU1**  Buzzer (build option)

Optional speaker. Driver circuit not populated, please contact PC Engines for instructions if you would like to add this.

## Status LEDs

Status LEDs are all turned on by the BIOS on power up. The BIOS will turn off LEDs 2 and 3 before booting the operating system.

| Location | GPIO | read port | write port |
|---|---|---|---|
| LED1 (left) | G6 | port 06100h bit 6 | port 06100h bit 6 / 22 |
| LED2 (middle) | G25 | port 06180h bit 9 | port 06180h bit 9 / 25 |
| LED3 (right) | G27 | port 06180h bit 11 | port 06180h bit 11 / 27 |

The CS5536 GPIO ports are programmed by 32 bit atomic writes. This avoids the need for read / modify / write operations and the locking issues they entail. For example, to turn off LED1 (high), write 0000'0040h to port 06100h. To turn on LED1 (low), write 0040'0000h. Multiple port bits can be changed at the same time.

## Mode switch

The mode switch can be accessed by software as follows:

| Location | GPIO | read port | |
|---|---|---|---|
| MODESW# | G24 | port 061b0h bit 8 | (active low, 0 = switch pressed) |

# BIOS POST codes

tinyBIOS writes POST / diagnostic codes to port 80h. To make these codes visible, use a miniPCI POST card such as PC Engines POST.5A. POST codes are:

01      reset entry
02      chipset initialization
03      detect base memory size
04      initialize shadow RAM
05      init mono video
06      disable PCI devices
07      test low 64KB of DRAM
08      initialize stack
09      BIOS checksum
0a      super I/O initialization
0b      RTC test
0c      refresh / 8254 test
0d      speed-dependent chipset regs
0e      test 8237 DMA
0f      test DMA page registers
10      test 8254 registers
11      test keyboard controller
12      init timer, DMA, 8259...
13      test 8259 mask registers
14      test low 640KB
15      init vectors
16      PCI plug & play
17      shadow video BIOS
18      look for VGA BIOS
19      sign-on prompt
1a      second keyboard test
1b      extended memory test
1c      enable interrupts
1d      test / init RTC
1e      init floppy disk
1f      option ROM scan
20      test parallel ports
21      test serial ports
22      enable coprocessor
23      floppy init
24      hard disk init
25      PS/2 mouse detect
26      timer/RTC check
27      OEM boot decision point
00      boot

33      NMI
F7      low 64KB memory test failed