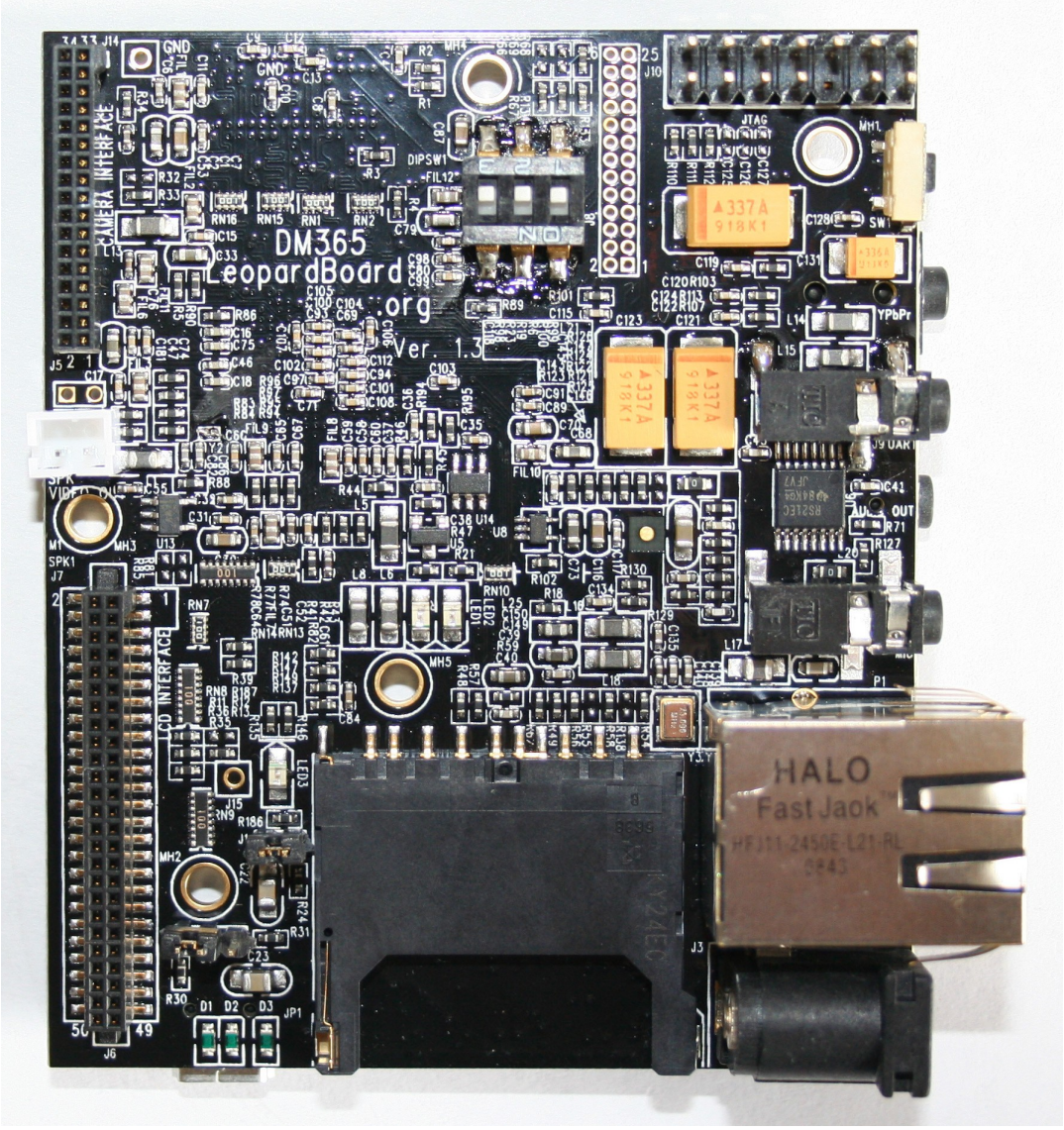


# Leopardboard 365 Hardware User Guide

Rev. 1.0

Feb 24, 2010

Leopardboard.org provides the enclosed product(s) under the following conditions:

This evaluation kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by Leopardboard.org to be a finished end-product. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards.

**The kit can't be returned, it can be exchanged if it is defect.**

The user assumes all responsibility and liability for proper and safe handling of the goods; it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

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**WARRANTY:** The Leopardboard 365 is warranted against defects in materials and workmanship for a period of **30 days** from purchase. This warranty does not cover any problems occurring as a result of improper use, modifications, exposure to water, excessive voltages, abuse, or accidents. All boards will be returned via standard mail if an issue is found. If no issue is found or express return is needed, the customer will pay all shipping costs.

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Fremont, CA 94539
USA

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## What's included?

**1.** This section is a description of what comes in the box when the Leopardboard 365 is purchased and Optional Parts provided for purchasing. See Figure 1

**Figure 1. Leopardboard 365 in Box**

**NOTE: Standard package only includes Leopardboard 365; all other optional parts are sold separately.**

### 1.1 Leopardboard 365, see Figure 2.

Where to buy: http://shop.leopardimaging.com/product.sc?producvmtId=30&categoryId=10

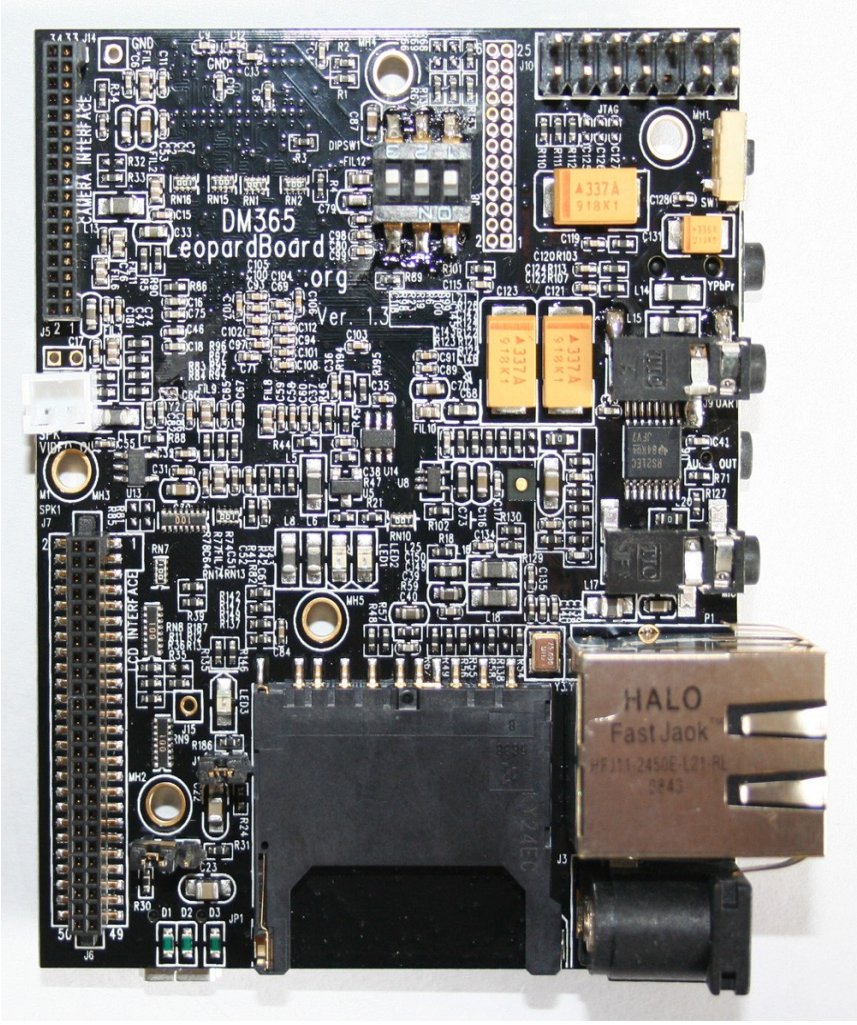


**Figure 2. Leopardboard 365**

## 1.2 Optional Parts, not included in the package, these parts have to be purchased separately

### 1.2.1 Serial Cable, see Figure 3.

- Part number: **LI-SER-01**
- One end is Female DB9 connector
- Another end is 2.5mm Stereo Plug connector
- Cable Length: 70”

Where to buy: http://shop.leopardimaging.com/product.sc?productId=14&categoryId=10

**Figure 3. Serial Cable**

### 1.2.2 +5V DC Power Adapter, see Figure 4.

- Part number: **LI-PS5-01**
- Wall Mount AC/DC Switching Power Supply (2-prong)
- Universal AC Input
- Power Input Frequency: 50/60Hz
- DC Output: 5VDC@2.5A
- Polarization: Positive Center
- Cord Plug: 2.1mm I.D. x 5.5mm O.D. x 12mm Female
- Cable length: 43”

Where to buy: http://shop.leopardimaging.com/product.sc?productId=13&categoryId=10

**Figure 4. +5V DC Power Adapter**

### 1.2.3 Mini-B USB Cable, see Figure 5.

- Part number: **LI-USB-01**
- One end: Mini-B
- One end: Type-A

Where to buy: http://shop.leopardimaging.com/product.sc?productId=15&categoryId=10

**Figure 5. Mini-B USB Cable**

### 1.2.4 Composite Video Cable, see Figure 6

- Part number: **LI-VIC-03**

Where to buy: http://shop.leopardimaging.com/product.sc?productId=33&categoryId=10

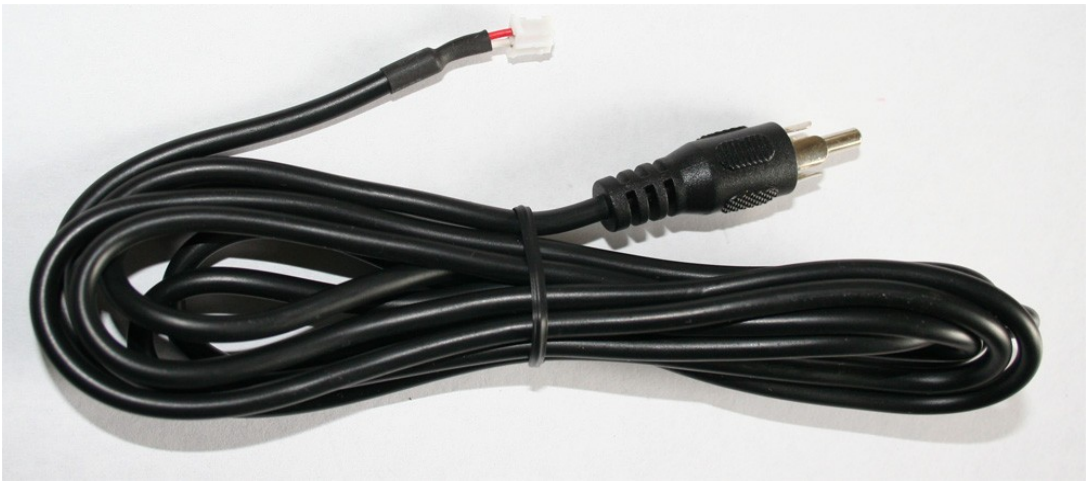

**Figure 6. Composite Video Cable**

### 1.2.5 Camera Boards

#### 1.2.5.1 VGA Camera Board, see Figure 7.

- Part number: **LI-LBCMVGA**
- Sensor: Micron/Aptina 1/11“ CMOS Sensor MT9V113
- # of Pixels: VGA (648 x 488 pixels)
- Output Data Format: YUV (YCbCr)
- Optical Filter: Infrared Coating at 650nm+/-10nm
- Focal Length, F#: f=1.34+/-0.1mm, F2.8+/-5%
- Vertical View Angle: 660
- Focus Distance: 40cm+/-2cm
- Focus Range: 20cm to Infinity
- RoHS Compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=8&categoryId=10

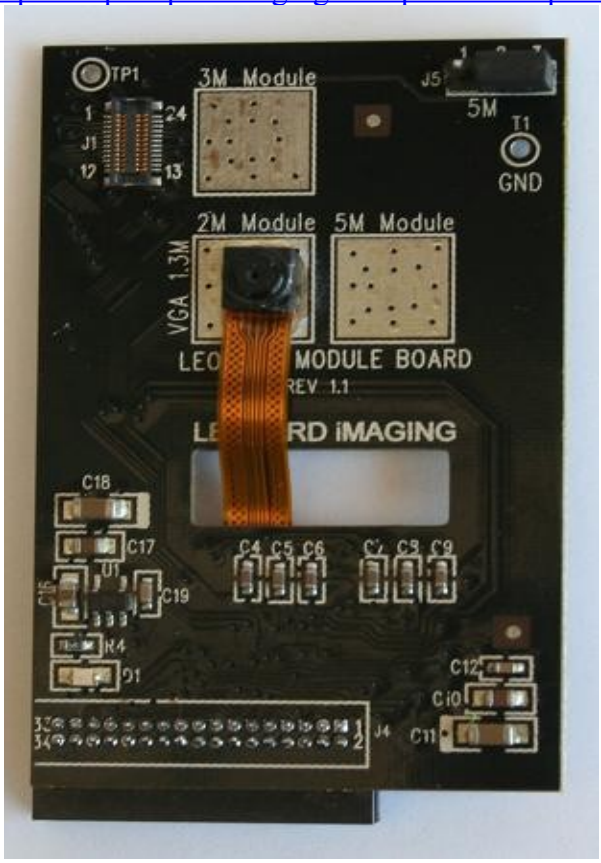


**Figure 7. VGA Camera Board**

#### 1.2.5.2 1.3 Mega-pixel Camera Board, see Figure 8

- Part number: **LI-LBCM1M1**
- Sensor: Aptina 1/4“ CMOS Sensor MT9M112
- # of Pixels: 1.3Mega (1280 x 1024 pixels)
- Output Data Format: YUV (YCbCr)
- Optical Filter: Infrared Coating at 650nm+/-10nm
- Focal Length, F#: f=4+/-0.1mm, F2.0+/-5%
- Vertical View Angle: 59.30
- Focus Distance: 120cm+/-2cm
- Focus Range: 60cm to Infinity
- RoHS compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=9&categoryId=10

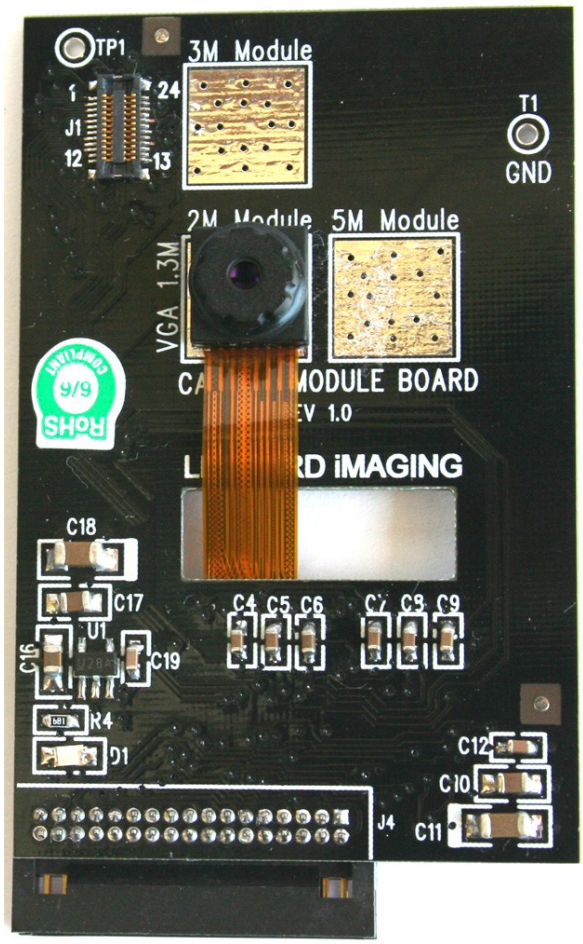


**Figure 8. 1.3M Camera Board**

#### 1.2.5.3 2 Mega-pixel Camera Board, see Figure 9

- Part number: **LI-LBCM2M1**
- Sensor: Aptina 1/4“ CMOS Sensor MT9D112
- # of Pixels: 2Mega (1600 x 1200 pixels)
- Output Data Format: YUV (YCbCr)
- Optical Filter: Infrared Coating at 650nm+/-10nm
- Focal Length, F#: f=3.79+/-0.1mm, F2.0+/-5%
- Vertical View Angle: 610
- Focus Distance: 120cm+/-2cm
- Focus Range: 60cm to Infinity
- RoHS Compliance

Where to buy:http://shop.leopardimaging.com/product.sc?productId=10&categoryId=10

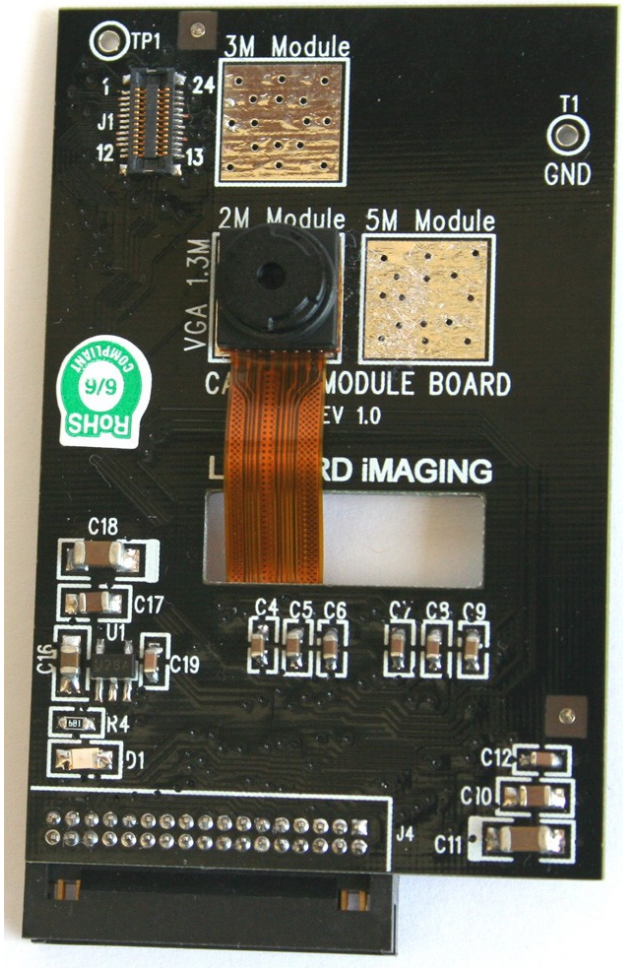


**Figure 9. 2M Camera Board**

#### 1.2.5.4 3 Mega-pixel Camera Board, see Figure 10

- Part number: **LI-LBCM3M1**
- Sensor: Aptina 1/4“ CMOS Sensor MT9T111
- # of Pixels: 3Mega (2048 x 1536 pixels)
- Output Data Format: YUV (YCbCr)
- Optical Filter: Infrared Coating at 650nm+/-10nm
- Focal Length, F#: f=3.78+/-0.1mm, F2.8+/-5%
- Vertical View Angle: 61.40
- Focus Distance: 120cm+/-2cm
- Focus Range: 60cm to Infinity
- RoHS Compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=11&categoryId=10

**Figure 10. 3M Camera Board**

#### 1.2.5.5 5 Mega-pixel Camera Board, see Figure 11

- Part number: **LI-LBCM5M1**
- Sensor: Aptina 1/2.5“ CMOS Sensor MT9P011
- # of Pixels: 5Mega (2592 x 1944 pixels)
- Output Data Format: RGB
- Optical Filter: Infrared Coating at 650nm+/-10nm
- Focal Length, F#: f=6.12+/-0.1mm, F2.8+/-5%
- Vertical View Angle: 60.30
- Focus Distance: 120cm+/-2cm
- Focus Range: 60cm to Infinity
- RoHS Compliance

Where to Buy: http://shop.leopardimaging.com/product.sc?productId=12&categoryId=10

**Figure 11. 5M Camera Board**

#### 1.2.5.6 5 Mega-pixel Camera Board, see Figure 12

- Part number**: LI-5M03**
- Sensor: Aptina 1/2.5“ CMOS Sensor MT9P031
- # of Pixels: 5Mega (2592 x 1944 pixels)
- Pixel Size: 2.2µm x 2.2µm
- Support 720p @ 60 fps
- Pixel Dynamic Range: 70.1dB at full resolution
- Output Data Format: RGB
- RoHS Compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=17&categoryId=10

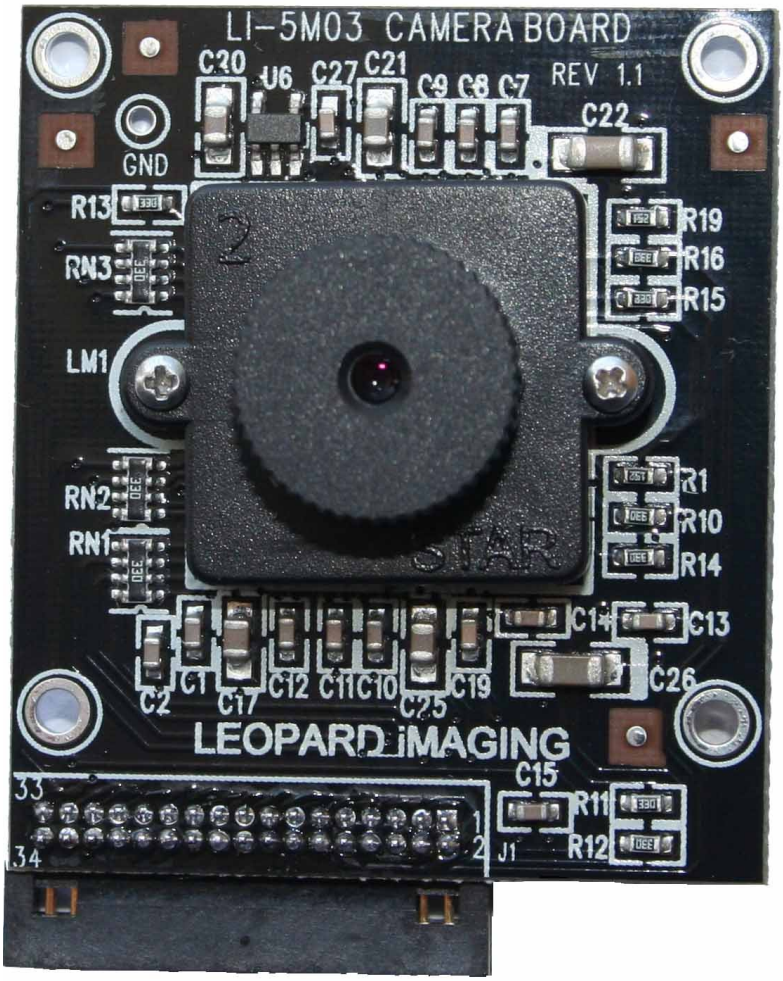


**Figure 12. LI-5M03**

#### 1.2.5.7 WVGA Global Shutter Camera Board, see Figure 13

- Part number: **LI-VM34LP**
- Sensor: Aptina 1/3" CMOS Digital Sensor MT9V034
- # of Pixels: VGA (752 x 480 pixels)
- Pixel Size: 6µm x 6µm
- Max Data rate: 27 Mega pixel Per Second
- Frame rate: 60 fps at full resolution
- Responsivity: 4.8 V/lux-sec (550nm)
- Support either M12 lens or CS-Mount lens
- RoHS Compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=29&categoryId=10

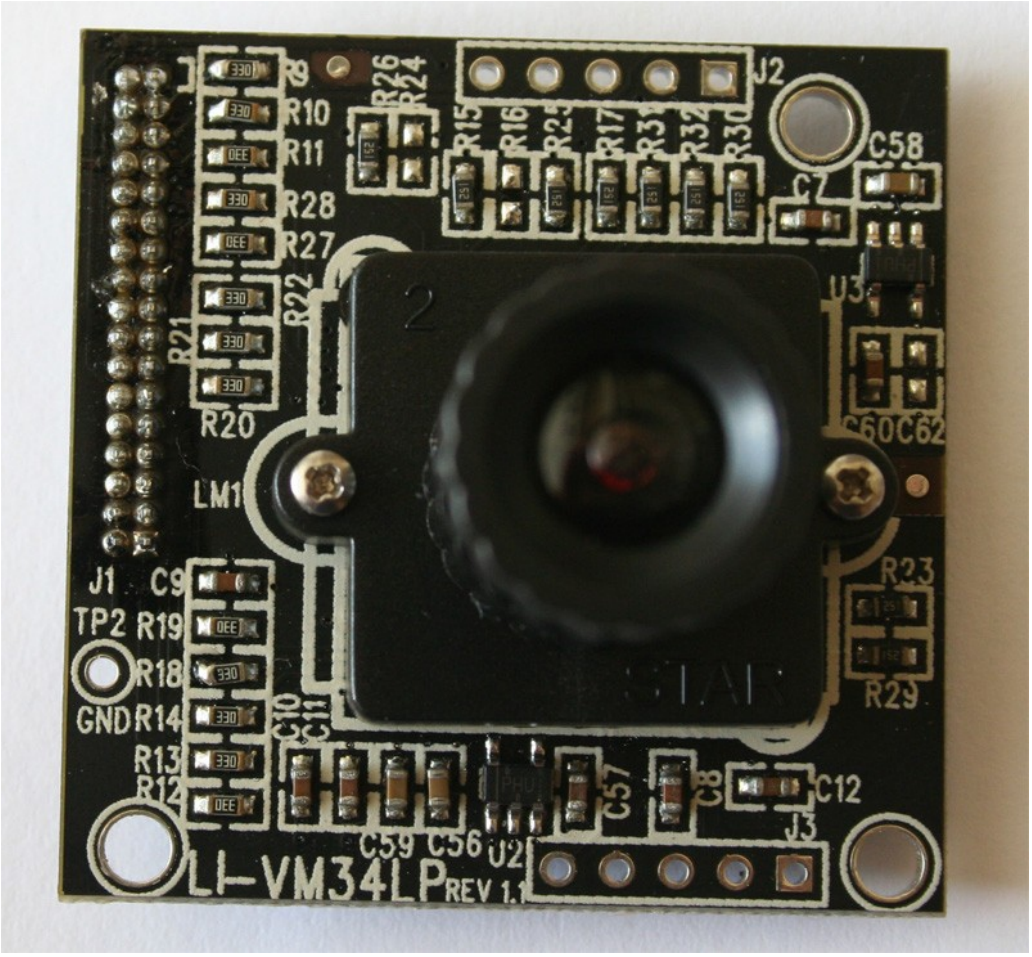


**Figure 13. WVGA Camera Board**

#### 1.2.5.8 Omni Vision 720p Camera Board, see Figure 14

- Part number: **LI-OV720**
- Sensor: Omnivision 1/4“ CMOS Sensor OV9712
- WXGA (1280 x 800), 30fps
- Pixel size: 3um x 3um
- Output Data Format: 10-bit raw RGB data
- Focal Length, F#: f=3.45+/-0.1mm, F2.8+/-5%
- View Angle: 65.9
- Focus Range: 40cm to Infinity
- RoHS Compliance

Where to buy: To be released.

**Figure 14. Omni Vision 720p Camera Board**

#### 1.2.5.9 Omni Vision 1080p Camera Board, see Figure 15

- Part number: **LI-OV1080**
- Sensor: Omnivision 1/3“ CMOS Sensor OV2710
- # of Pixel: 1920 x 1080
- Image size: 1080p @ 30fps
- Pixel size: 3um x 3um
- Output Data Format: 8-/10-bit raw RGB data
- RoHS Compliance

Where to buy: To be released.

**(Sorry, Figure 15 is currently unavailable)**

#### 1.2.5.10 DVI board, see Figure 16

- Part number: **LI-DVI1**
- Support standard DVI output
- Pico DLP compatible
- RoHS Compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=27&categoryId=10

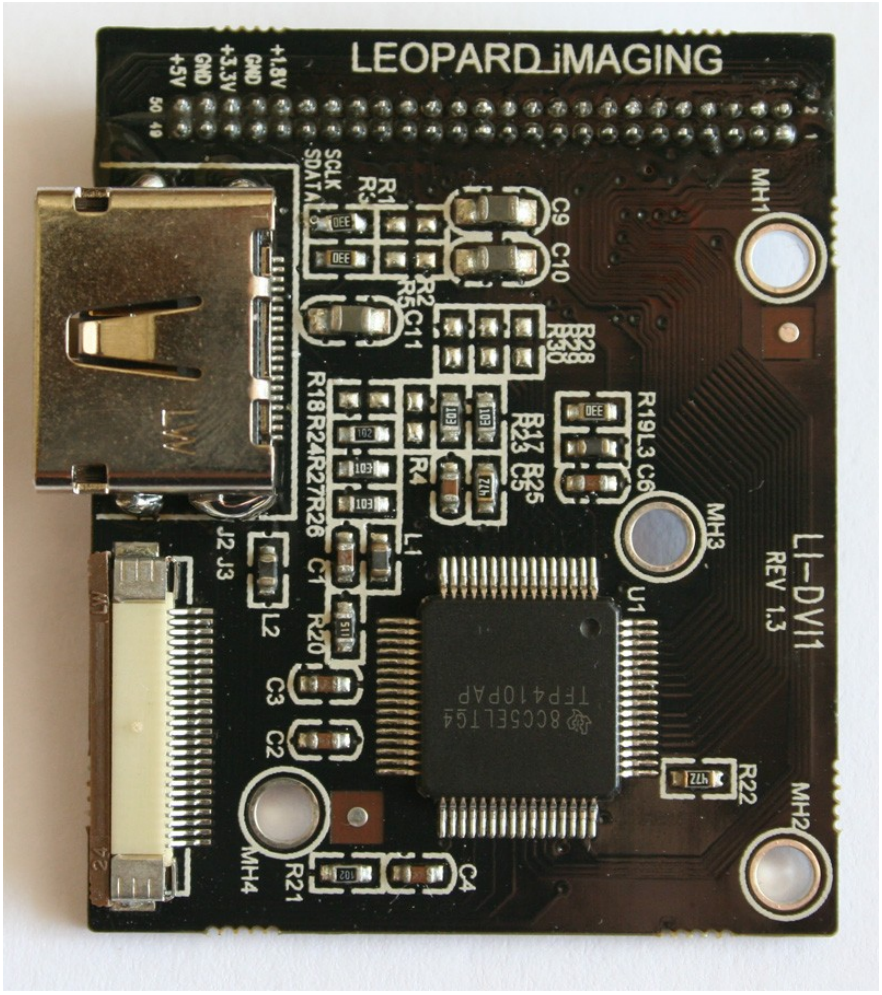


**Figure 16. DVI Board**

### 1.2.6 Video Input board, see Figure 17

- Part number: **LI-VI365**
- Support standard S-video/Composite video input
- RoHS Compliance

Where to buy: To be released.

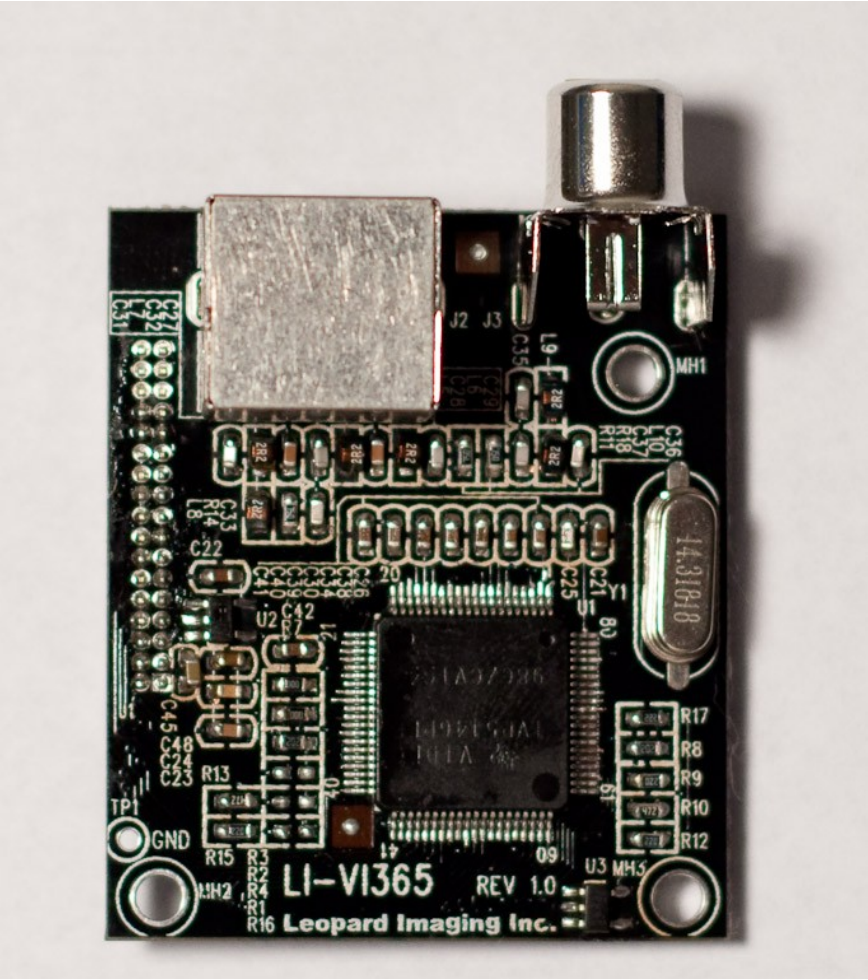


**Figure 17. Video Input Board**

### 1.2.7 HD Component Video Input Board, see Figure 18

- Part number: **LI-HDI365**
- Support Component Video input
- RoHS Compliance

Where to buy: To be released.

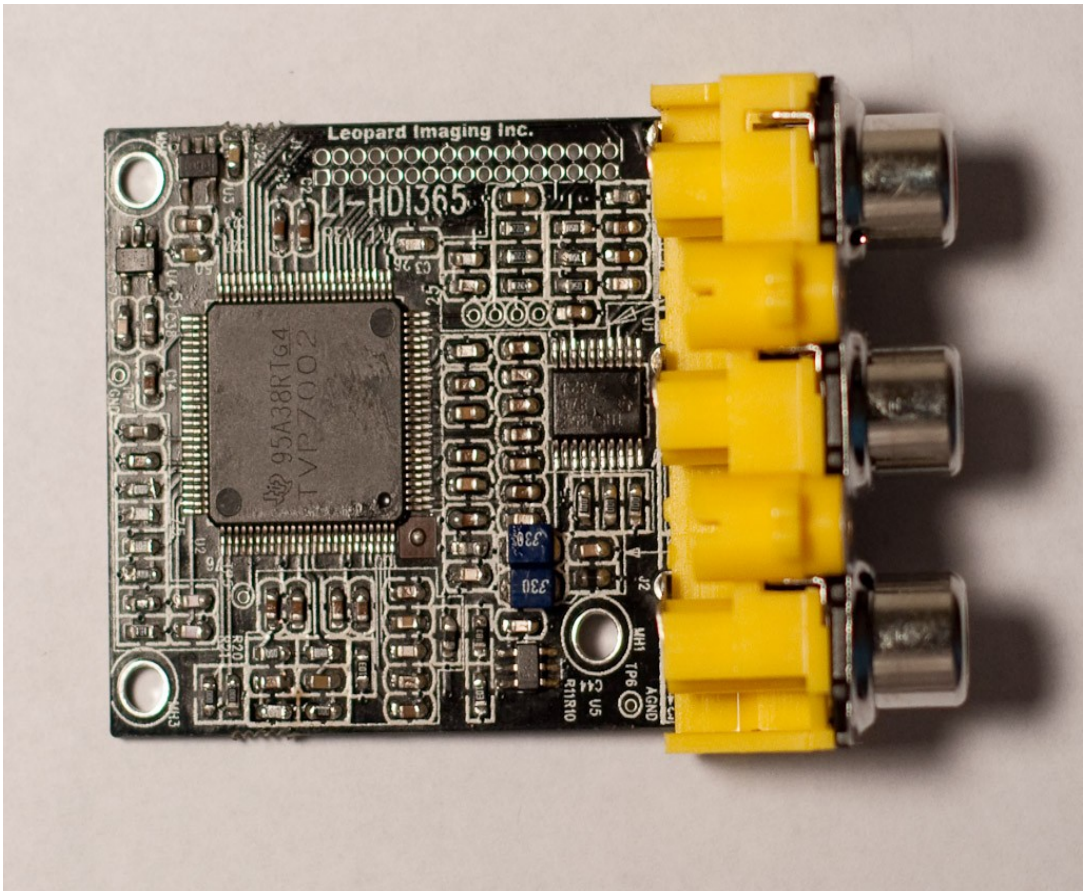


**Figure 18. HD Component Video Input Board**

### 1.2.8 Component Video Adapter Cable, see Figure 19

- Part number: **LI-VIC-02**
- Convert Stereo phone jack to Y/Pb/Pr RCA connector
- RoHS Compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=28&categoryId=10

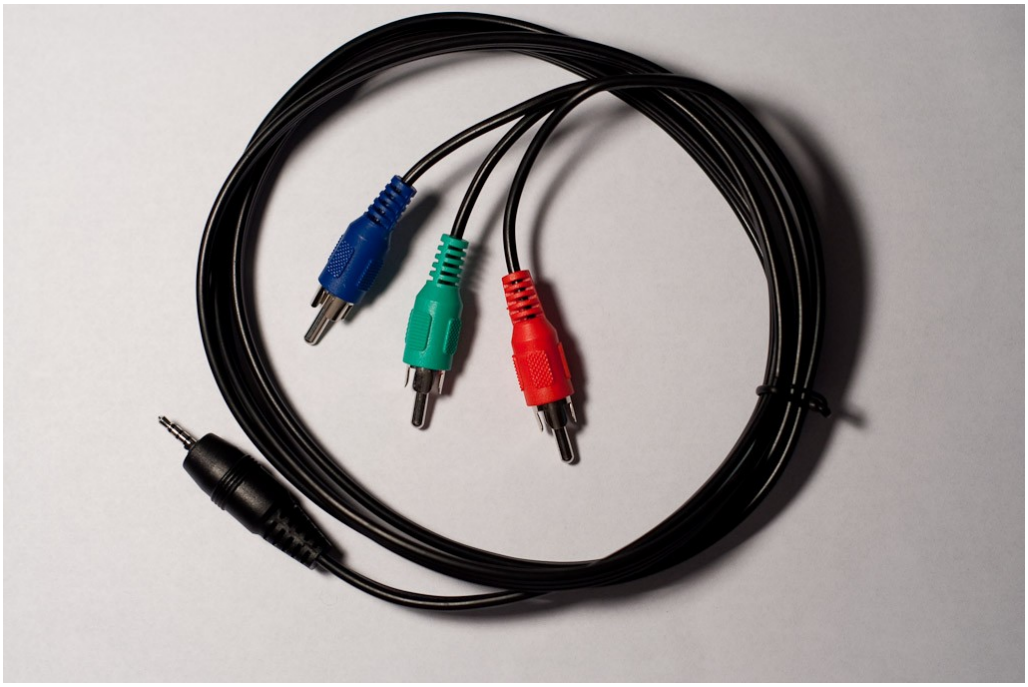

**Figure 19. Component Video Adapter Cable**

1.2.9 **Cam Flex Cable, see Figure 20**

- Part number: **LI-CAMFLEX**
- Length: 2”
- Connect between camera board and Leopardboard 365
- RoHS Compliance

Where to buy: http://shop.leopardimaging.com/product.sc?productId=32&categoryId=10

**Figure 20. Cam Flex Cable**

### 1.2.10 24-pin Flex Cable (Figure 21)

- Part number: **LI-FLEX01**
- Length: 4”
- Connect between DVI board and Pico Projector.

Where to buy: http://shop.leopardimaging.com/product.sc?productId=31&categoryId=10

**Figure 21. 24-pin Flex Cable**

# Leopardboard 365 Specification

**2.** This section covers the specifications of the Leopardboard 365 and it also provides a high level description of the major components and interfaces that make up the Leopardboard 365.

## 2.1 Leopardboard 365 features

**Table 1** provides a list of the Leopardboard 365 features.

| | Features |
|---|---|
| **Processor** | TMS320DM365 Processor |
| **NAND Flash** | 2Gb Micron NAND Flash (256MB) |
| **DDR2 SDRAM** | 1Gb Micron DDR2 SDRAM (128MB) |
| **Camera Interface** | VGA, 1.3M, 2M, 3M and 5 Mega-pixel CMOS Sensors supported |
| **Audio In/Out** | AIC3104 Audio chip, Stereo Audio In/Out, 2.5mm Stereo Plug connector |
| **JTAG Port** | JTAG Debug Port |
| **Serial Port RS-232** | UART Debug Port, 2.5mm Stereo Plug connector |
| **USB 2.0 Port** | USB 2.0 HS (Device can be powered by USB port), support both Host and Device Mode |
| **SD Card Slot** | SD/MMC Slot |
| **Power Management** | TPS65053 Power management chip |
| **Power Input** | +5V Power Input, 2.1mm I.D. x 5.5mm O.D. x 12mm Female |
| **Composite Video Output Port** | PAL/NTSC Output |
| **Component Video Output Port** | HD Component YPbPr Output |
| **Network Interface** | 10/100 Ethernet |
| **LCD/DVI Interface** | LCD/DVI Interface through adapter board |
| **Expansion Port (Not Populated)** | SD/MMC, I2C, UART, McBSP, GPIO, 3.3V power supply |
| **PCB Board Mechanical** | 3” x 2.5” (76.2mm x 63.5mm) |

## 2.2 Leopardboard 365 Function Block, see Figure 22

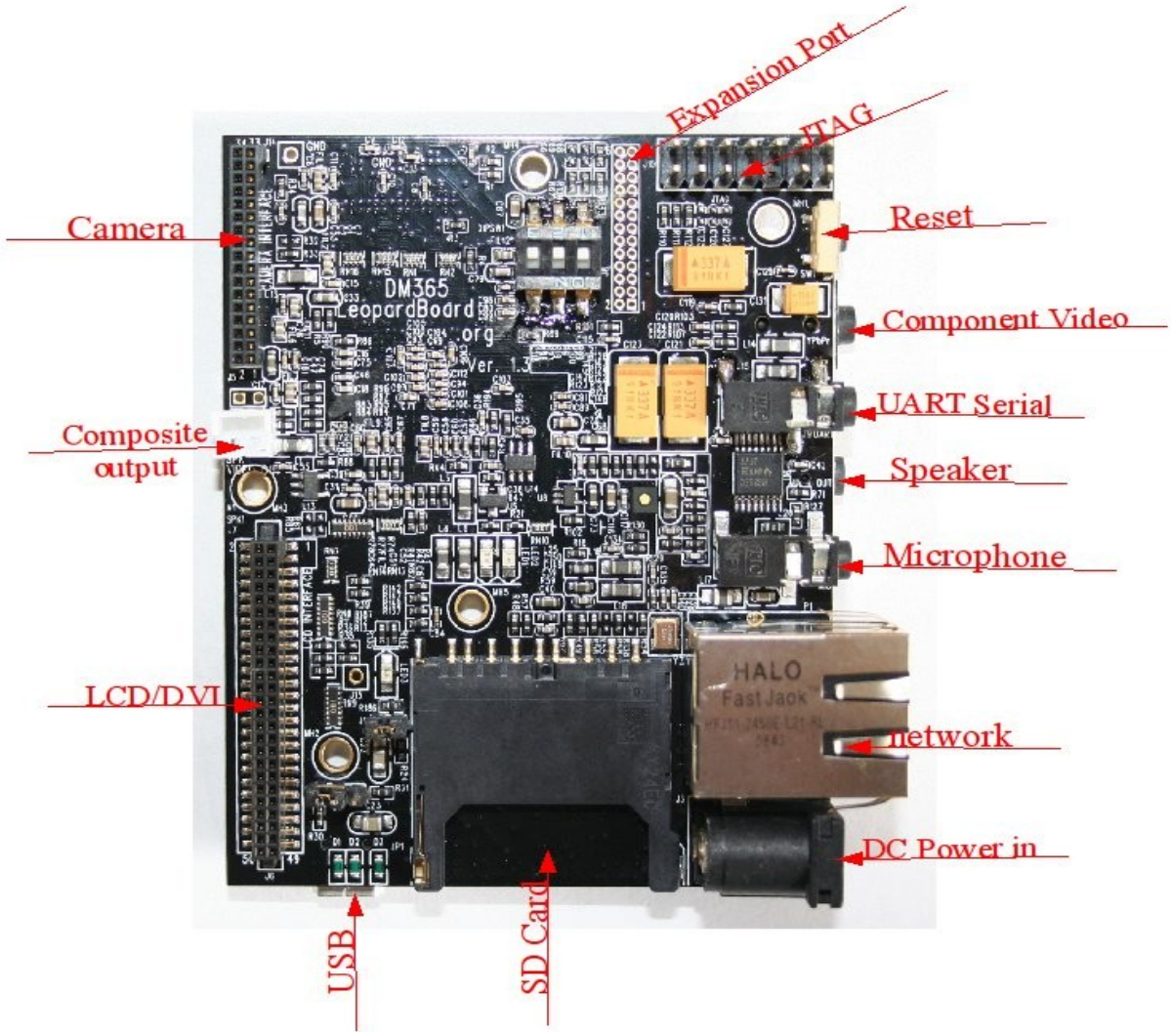


**Figure 22. Leopardboard 365 Function Block**

The following sections provide more detail on each feature and components on the Leopardboard 365.

## 2.3 DM365 Processor

The Leopardboard 365 takes TMS320DM365 as its main processor. The DM365 is a highly integrated, programmable platform for digital still camera, digital photo frames, IP security cameras, video door bell application, etc. This ARM9-based DM365 device supports production-qualified H.264, MPEG-4, MPEG-2, MJPEG and VC1/WMV9 codecs providing customers with the flexibility to select the right video codec for their application. The DM365 also enables seamless interface to most additional external devices required for a complete digital camera implementation. The image sensor interface is flexible enough to support CCD, CMOS, and various other interfaces such as BT.565, BT1120. The DM365 also offers a high level of

integration with HD display support including, 3 built-in 10-bit HD Analog Video Digital to Analog Converters (DACs), DDR2/mDDR, Ethernet MAC, USB 2.0, integrated audio, Host Port Interface (HPI), Analog to Digital Converter, and many more features saving developers on overall system costs as well as real estate on their circuit boards allowing for a slimmer, sleeker design. The DM365 processor core is an ARM926EJ-S RISC processor offering speeds up to 300MHz. The ARM926EJ-S is a 32-bit processor core that performs 32-bit and 16-bit instructions and processes 32-bit, 16-bit, and 8-bit data. The core uses pipelining so that all parts of the processor and memory system can operate continuously. See Figure 23

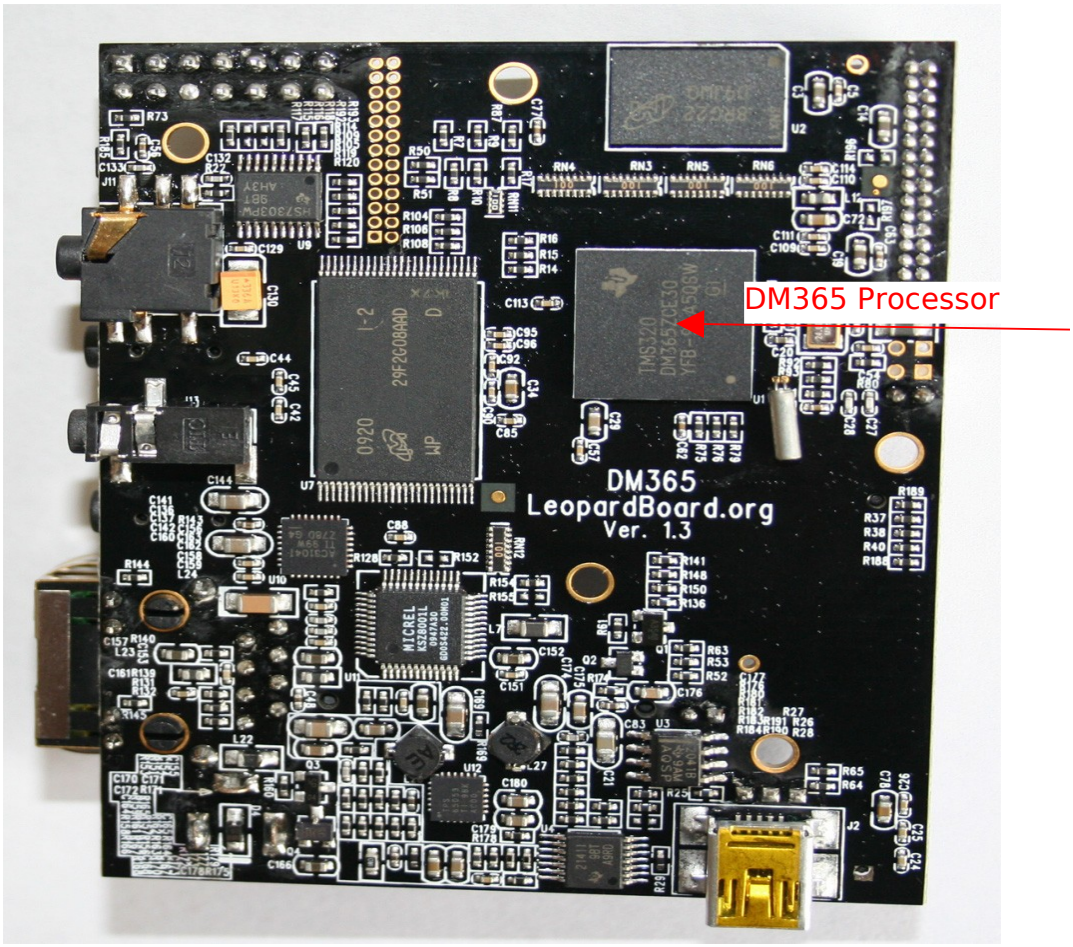


**Figure 23. DM355 Processor**

## 2.4 Flash Memory

The Micron Flash Memory is used in Leopardboard 365, it is a +3.3V powered, 256M x 8-bit, 2Gb SLC NAND Flash. It is compatible with 1Gb NAND Flash, see Figure 24.

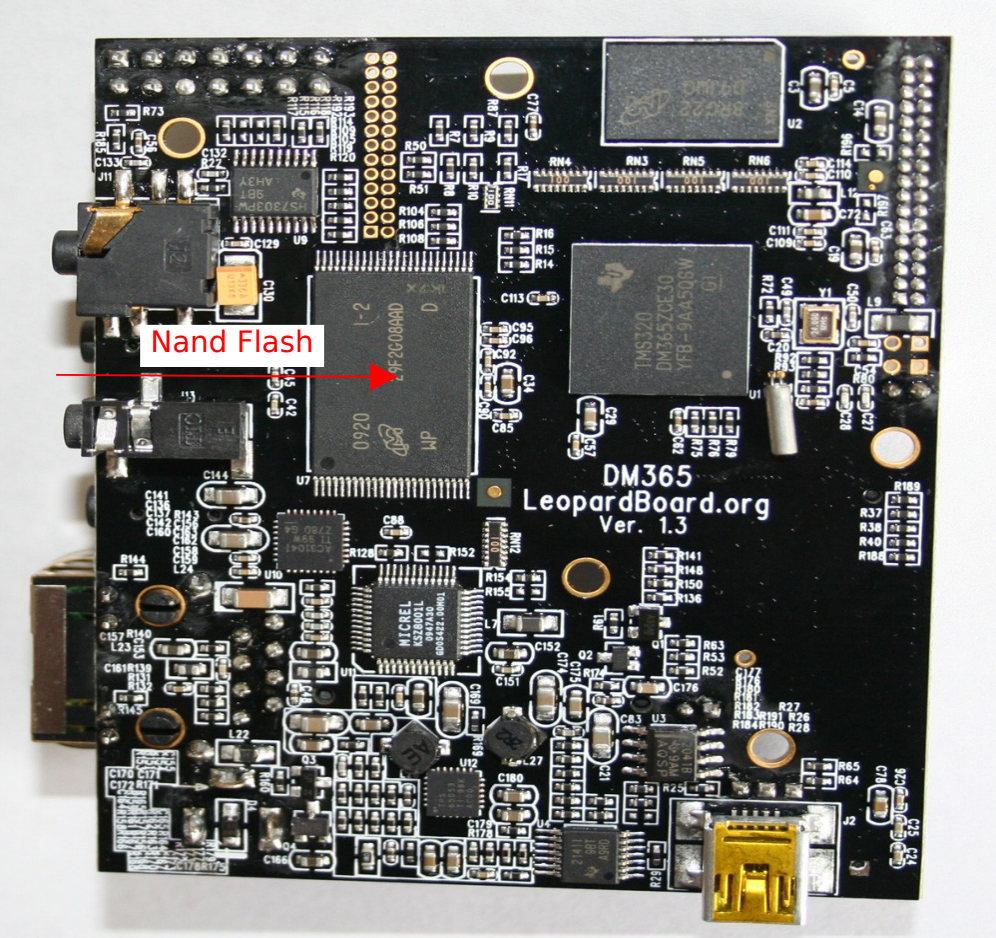


**Figure 24. NAND Flash**

## 2.5 DDR2 SDRAM

The Micron DDR2 SDRAM is used in Leopardboard 365, it is a +3.3V powered, 8M x 16 x 8 banks, 1Gb DDR2 SDRAM, see Figure 25

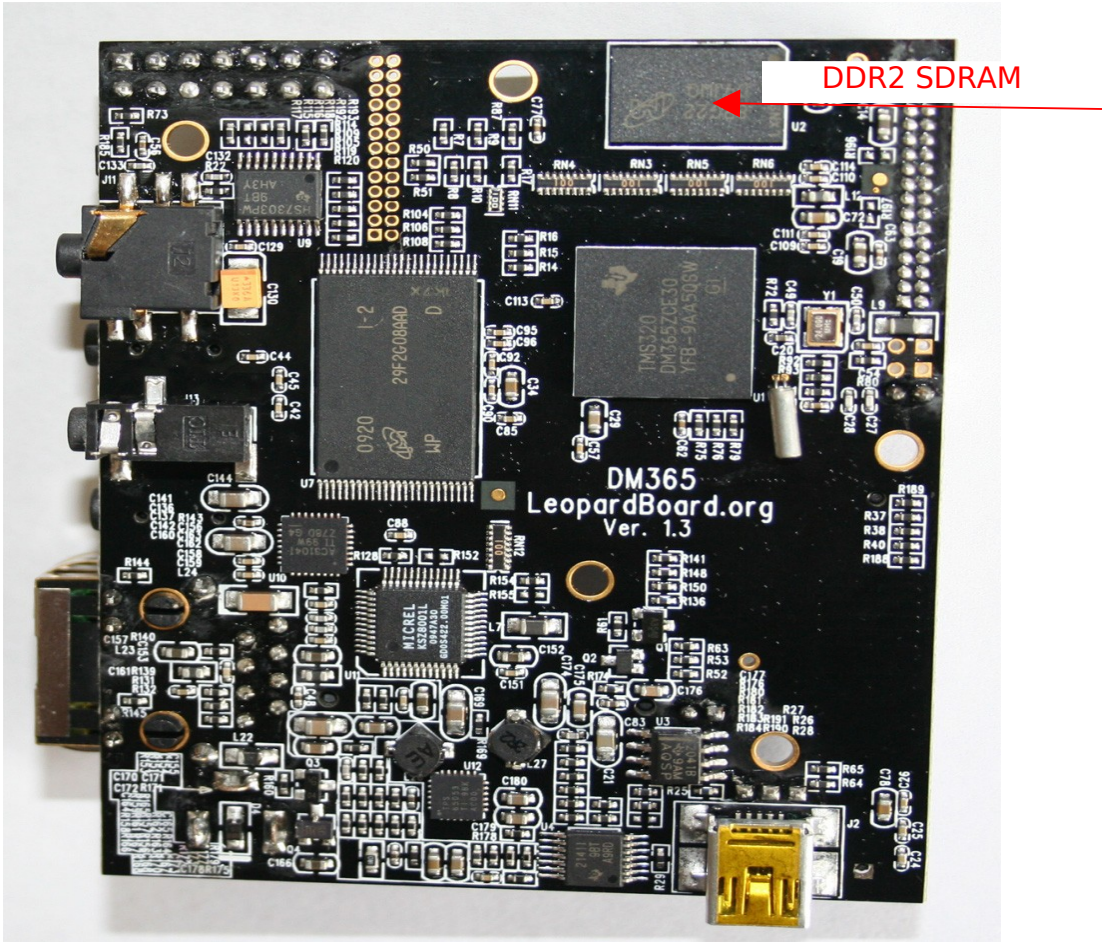


**Figure 25. DDR2 SDRAM**

## 2.6 Camera Interface

Leopardboard 365 supports wide range of CMOS Imagers from VGA, 1.3M, 2M, 3M to 5 Mega-pixel CMOS sensors, see Figure 26.

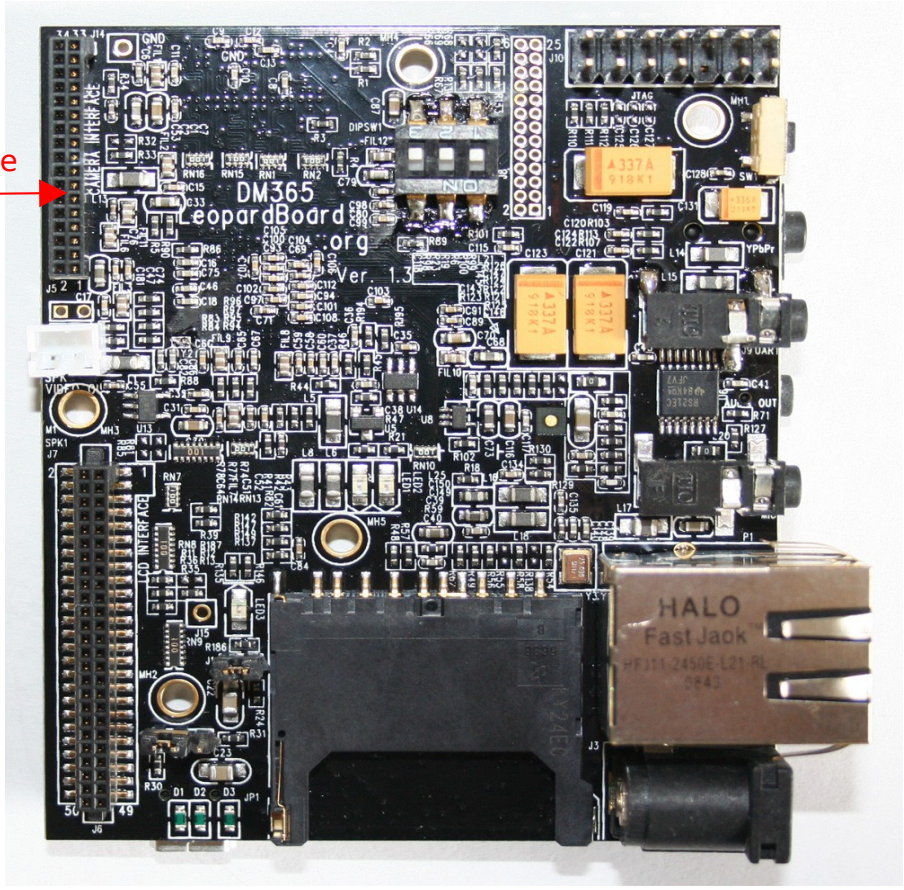


**Figure 26. Camera Interface**

Camera interface Pin assignment, see Figure 27.

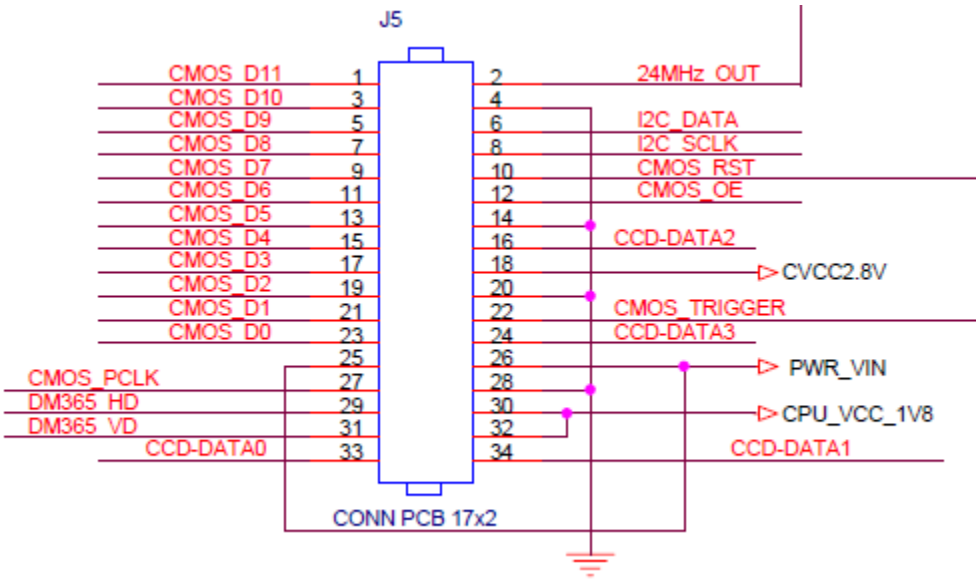


**Figure 27. Camera Interface Pin assignment**

## 2.7 Audio Input

Low power stereo audio CODEC TLV320AIC3104 is used in Leopardboard 365; a 2.5mm standard stereo audio input jack is provided to receive stereo audio input to CODEC, see Figure 28.

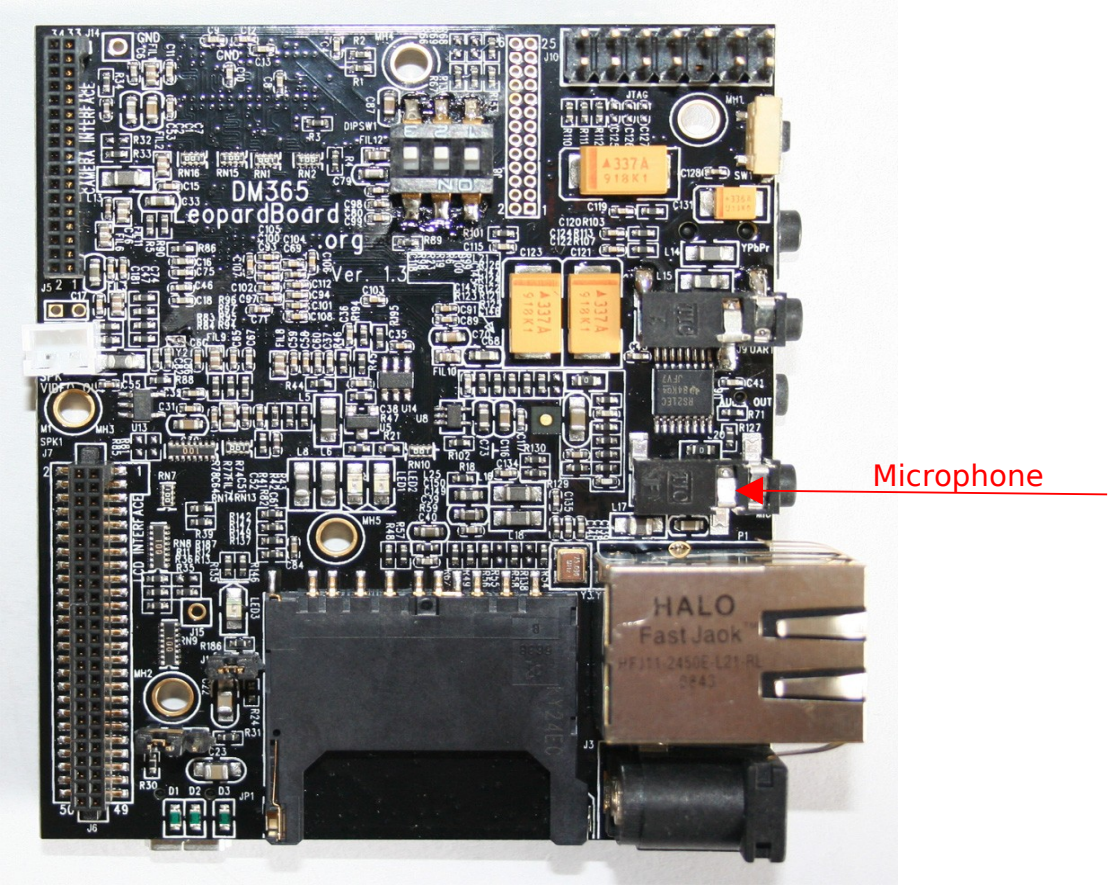


**Figure 28. Audio Input**

## 2.8 Audio Output

A 2.5mm standard stereo audio output jack is provided to access the stereo output of the onboard output CODEC, see Figure 29.

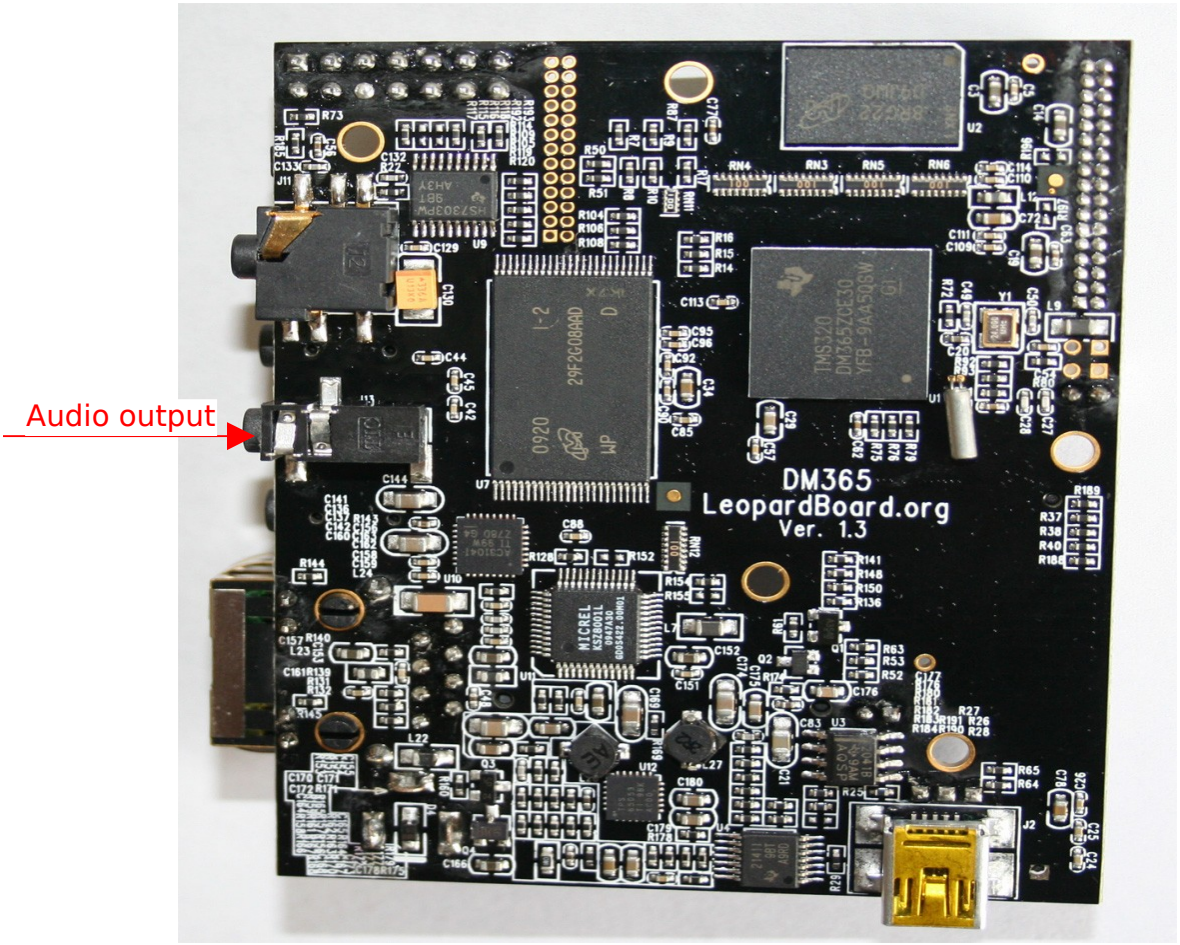


**Figure 29. Audio Output**

## 2.9 JTAG Port

A 14 pin JTAG header is provided on the Leopardboard 365 to facilitate the SW development and debugging of the board by using various JTAG emulators, see Figure 30.

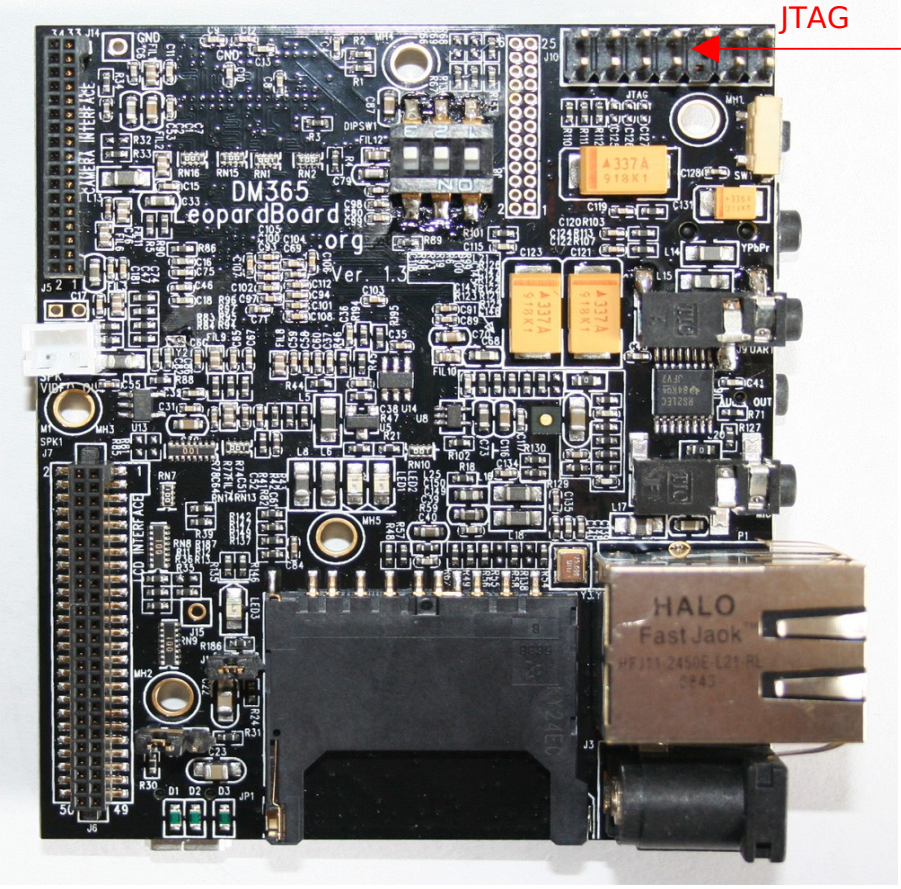


**Figure 30. JTAG Connector**

JTAG connector pin assignment, see Figure 31.

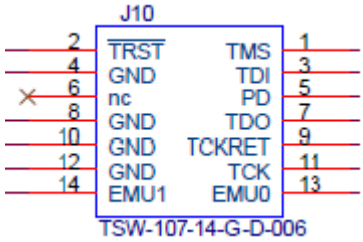


**Figure 31. 14-pin TI JTAG Interface**

## 2.10 Serial Port: RS-232

Support for RS232 is provided by a 2.5mm stereo audio jack on the Leopardboard 365 for access to an onboard RS232 transceiver. It does require a 2.5mm stereo audio jack to DB9 Female converter cable, which is an accessory part, to access the serial port, see Figure 32.

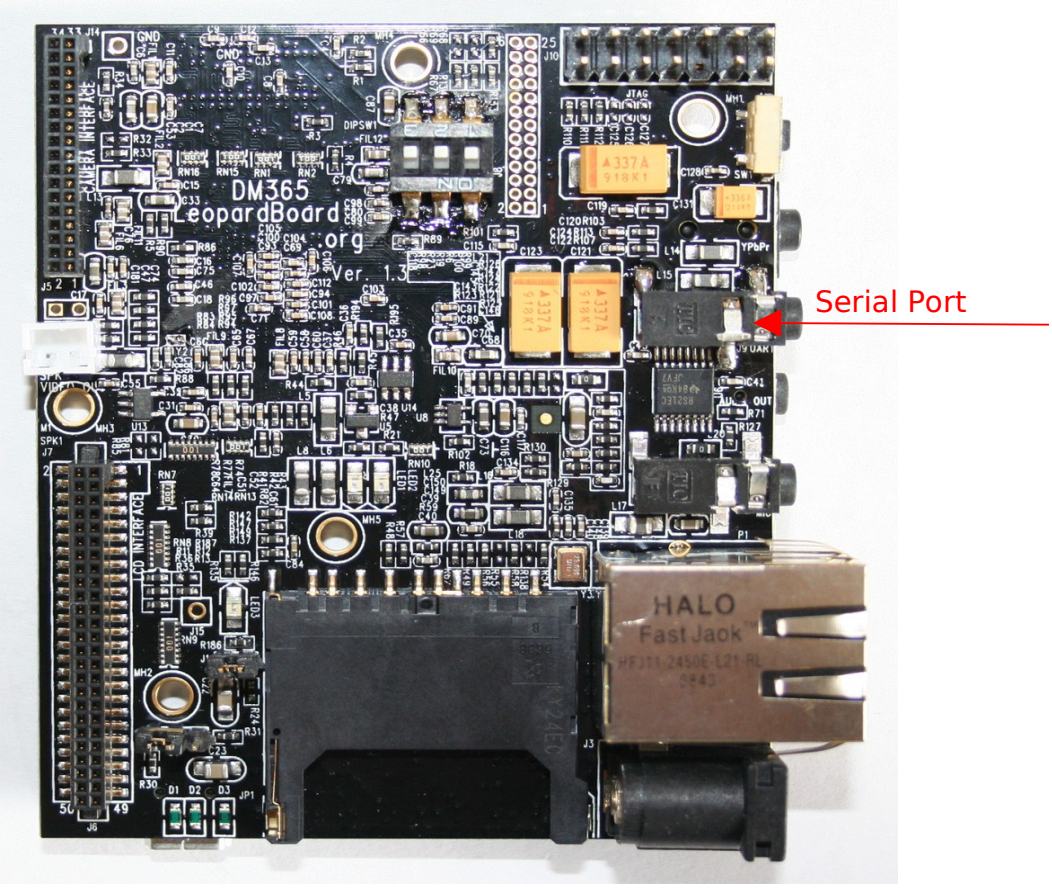


**Figure 32. UART Serial Port**

## 2.11 USB 2.0 Port and USB Host Mode

Leopardboard v1.3 supports USB device mode and host mode. (By default, the hardware is set to device mode) To change between these two modes, J1 and J4 needs to be adjusted accordingly. For these two jumpers, J1 has 2 pins and J4 has 3 pins. Please see Figure 33 for pin assignment of J4.

For device mode, no jumper should be placed on J1 while the jumper on J4 should stay on Pin 1 & Pin 2. For host mode, jumper should be placed on J1 while the jumper on J4 should stay on Pin 2 & Pin 3.

Please see Figure 34 for the position of J1, J4 and the USB port.

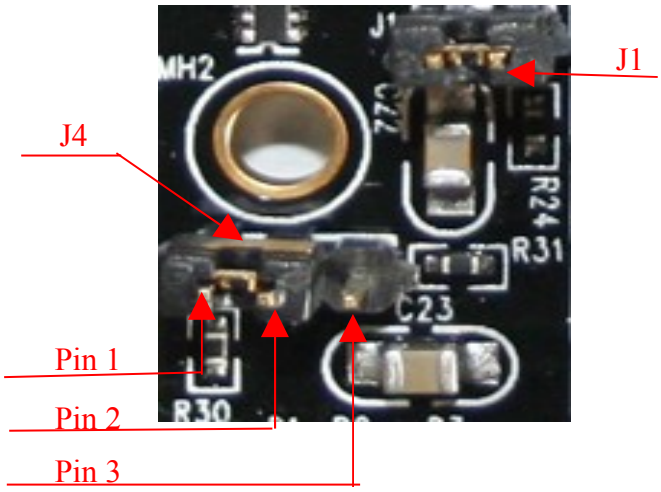


**Figure 33 Pin assignment of J4**

**Table 2 Jumper settings related to host & device mode**

| Mode | J1 Setting | J4 Setting |
|---|---|---|
| Device Mode | No Jumper | Jumper on Pin1 & Pin 2 |
| Host Mode | Jumper | Jumper on Pin 2 & Pin 3 |

The Leopardboard 365 requires a mini-B to USB type-A cable. Leopardboard 365 can be accessed through USB cable, there is an option to provide +5V power to the Leopardboard 365 if external +5V power supply is not used.

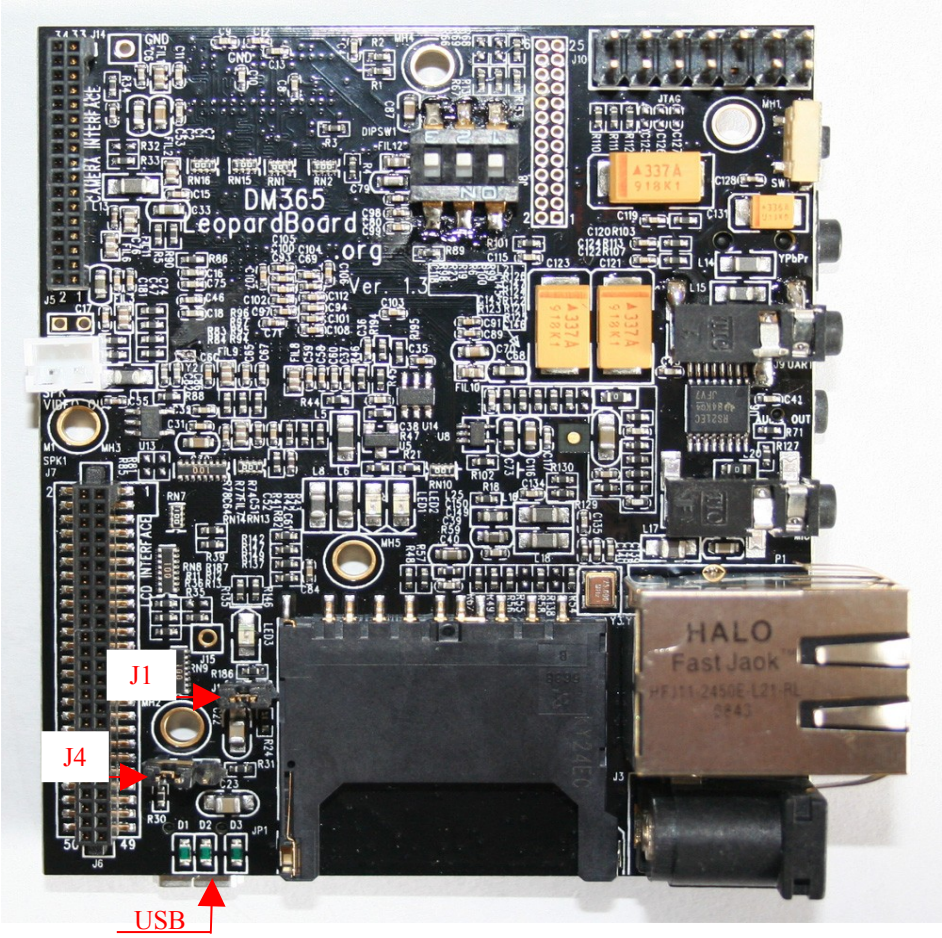


**Figure 34. USB port and J1 J4**

## 2.12 SD Card Slot

A SD Card connector is provided as a means for expansion and can support such devices, but not limited as SD memory card, miniSD card, GPS modules, WiFi card, and Bluetooth card, see Figure 35.

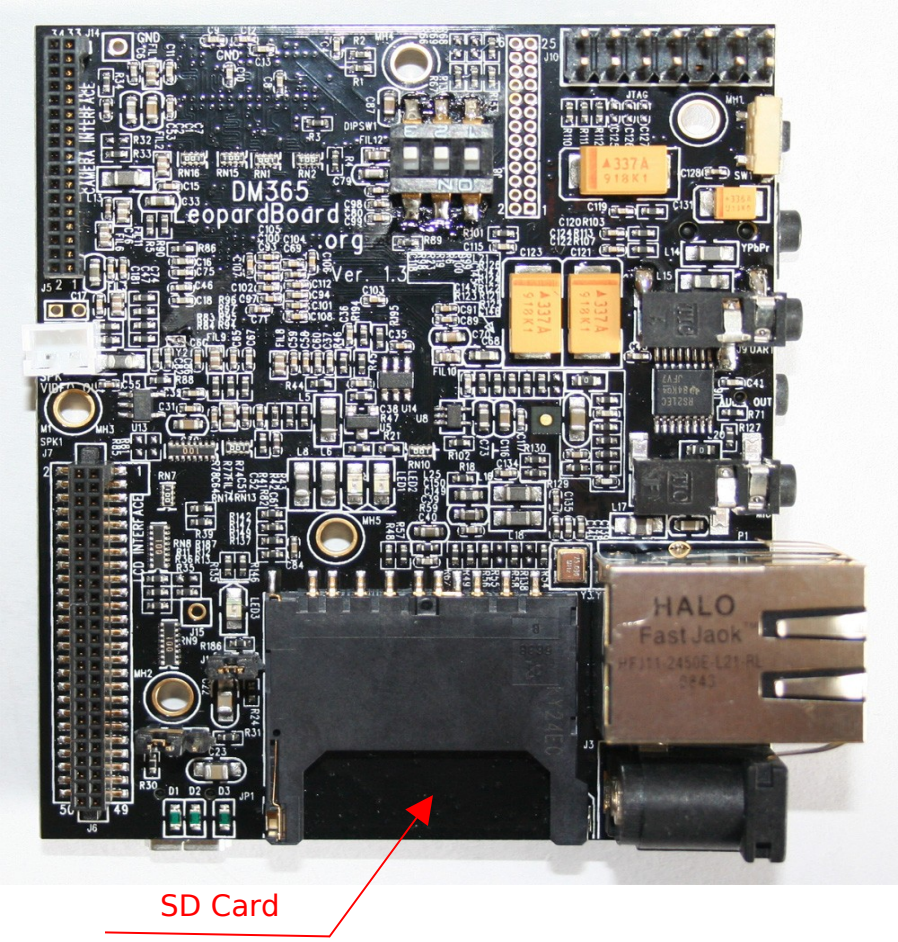


**Figure 35. SD Card**

## 2.13 Power Management

A powerful 5-Channel Power Management IC with two step down converters and 3 low-input voltage LDOs chip TPS65053 is provided in Leopardboard 365. It serves all powers on the board, see Figure 36.

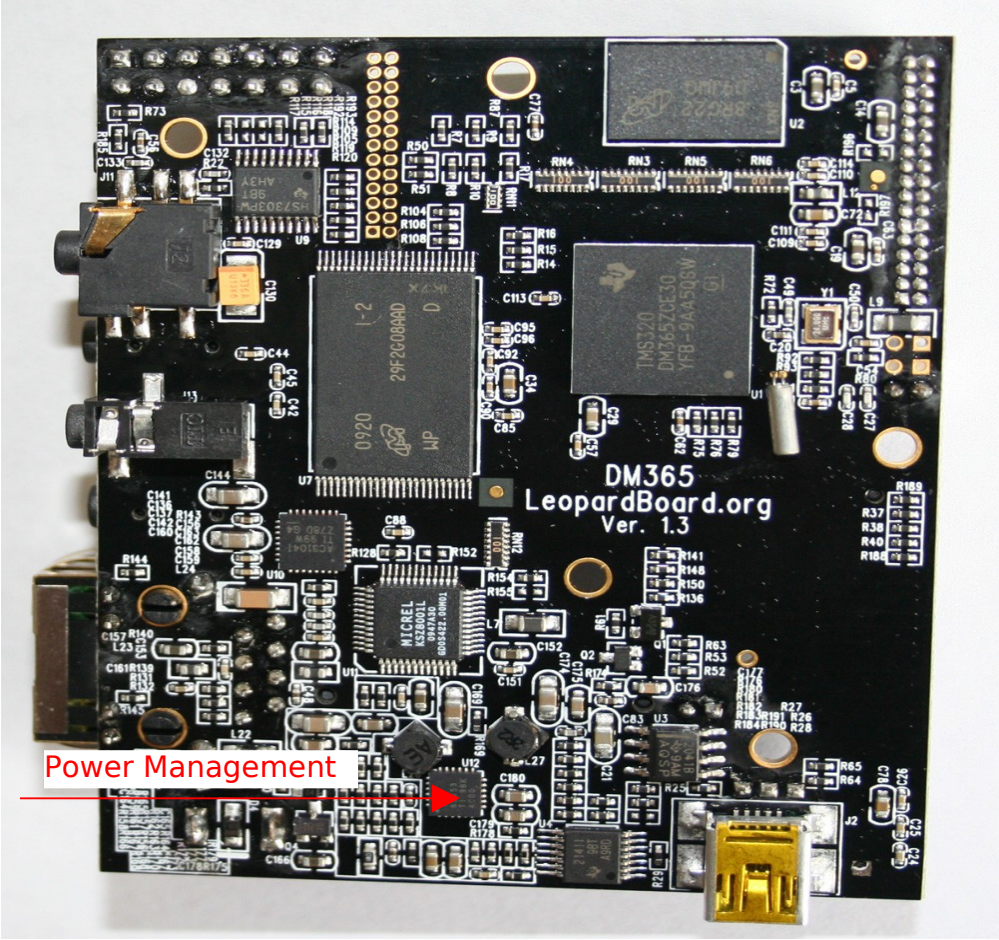


**Figure 36. Power Management**

## 2.14 Power Input

A 2.1mm standard power jack is provided in Leopardboard 365 for +5VDC power supply, the Leopardboard 365 power consumption is less than 2W, which includes 5M camera board power consumption running at 720p @ 30fps.

A standard 2.1mm jack wall supply is needed, which is an accessory part, power can also be supplied via the USB connector as an alternative supply,

When external power supply is provided, it will remove the power path from the USB connector.

**DO NOT plug in anything but 5V to the power jack, or the board will be possibly damaged although the board has over voltage protection function,** see Figure 37.

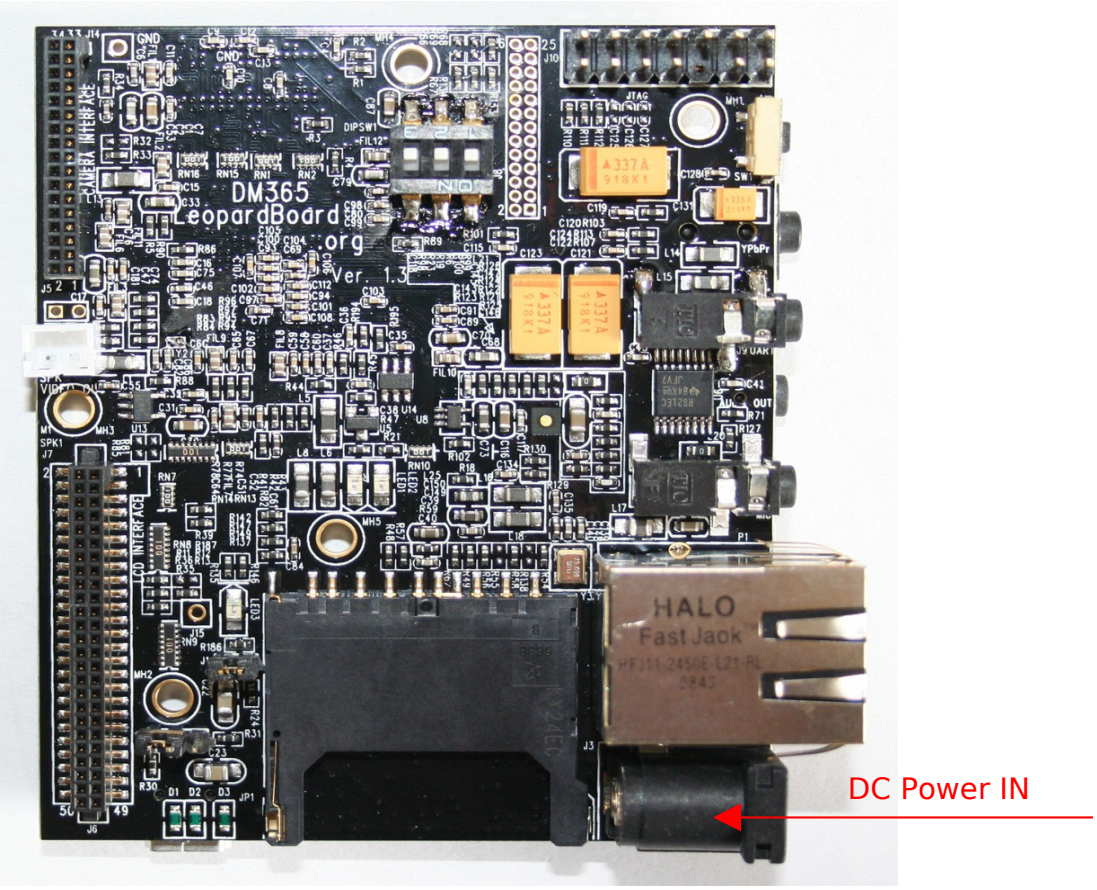


**Figure 37. DC Input**

## 2.15 Composite Video Output Port

A two video pins is provided to access composite video output of Leopardboard 365. It supports NTSC or PAL format output to a standard TV. The default is NTSC, but can be switched to PAL by software, see Figure 38.

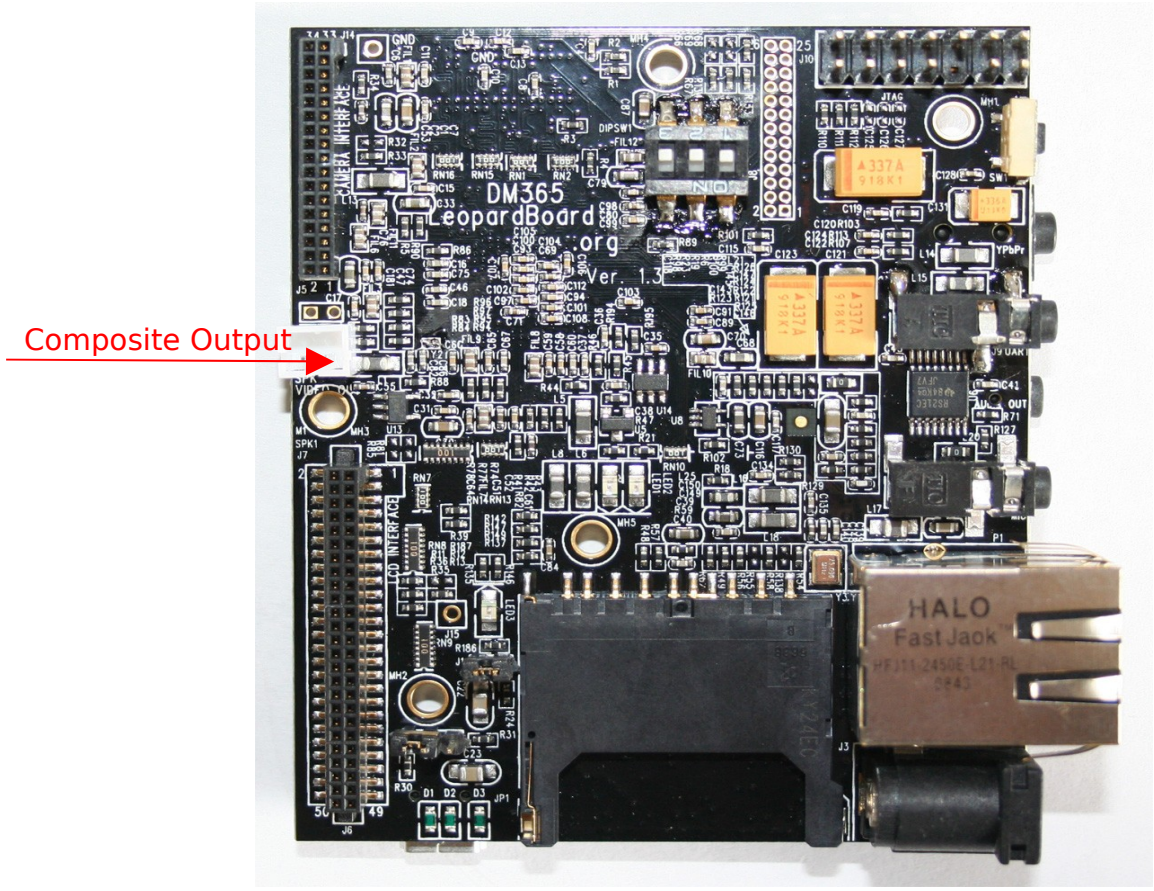


**Figure 38. Composite Output**

## 2.16 Component Video Output

Leopardboard 365 has provided a jack to access component video output supporting YPbPr format to output to a TV or other component. See Figure 39.

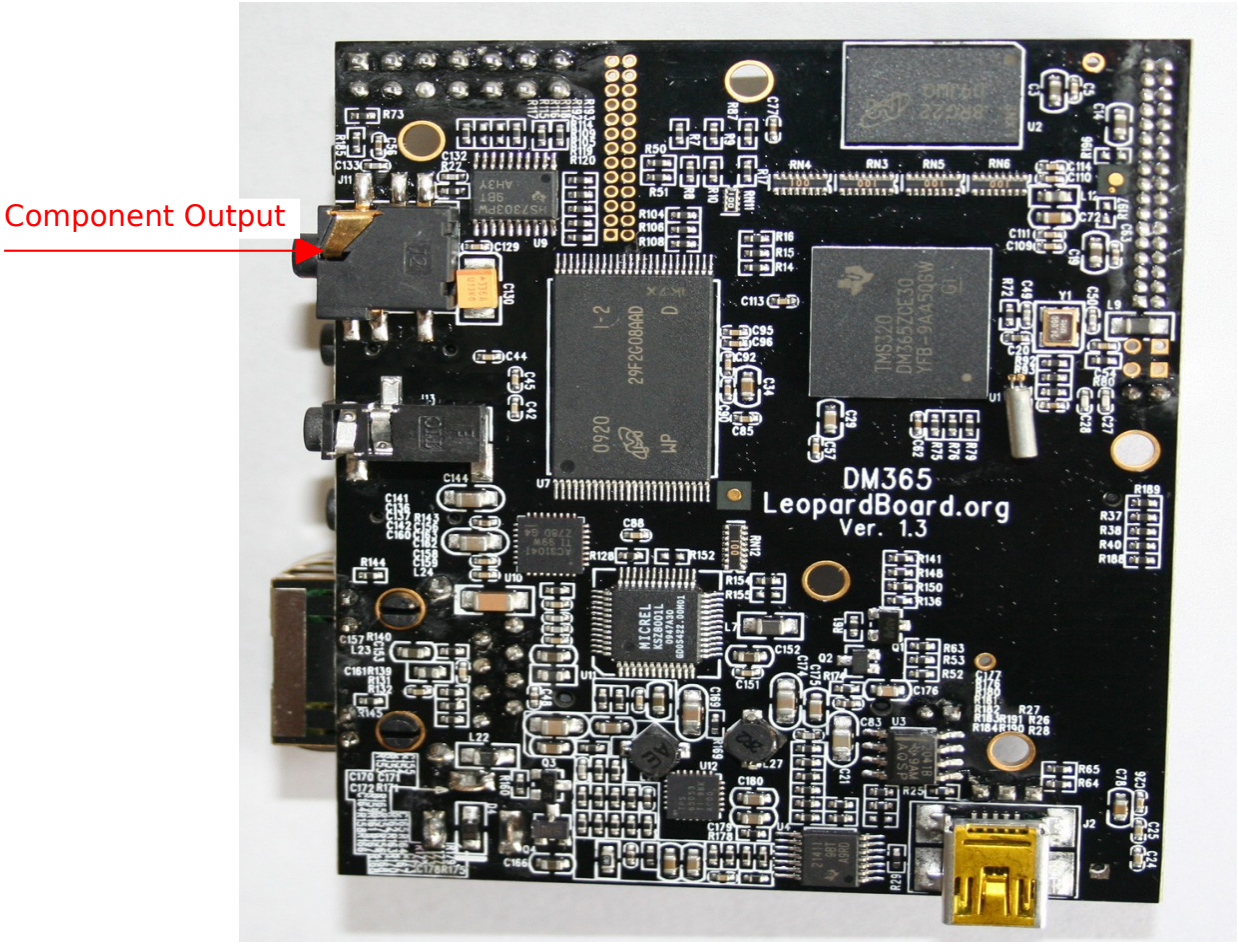


**Figure 39. Component Video Output**

## 2.17 Network Interface

Network is provided in Leopardboard 365, this is a standard RJ-45 connector for 10/100 Mbps Ethernet networks, see Figure 40.

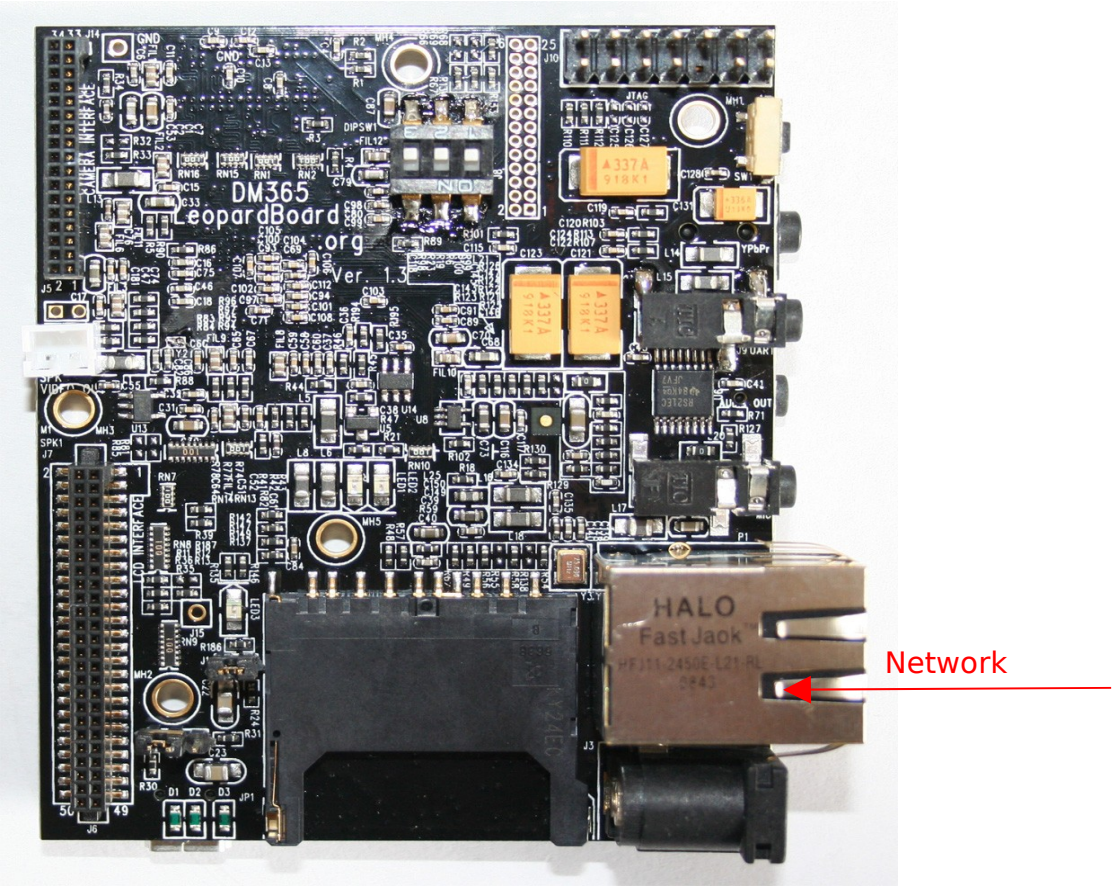


**Figure 40. Network Interface**

## 2.18 LCD/DVI Interface

Leopardboard 365 provides a 50-pin connector, which is fully compatible with DM365EVM expansion connector; it supports LCD daughter card or DVI daughter card, see Figure 41.

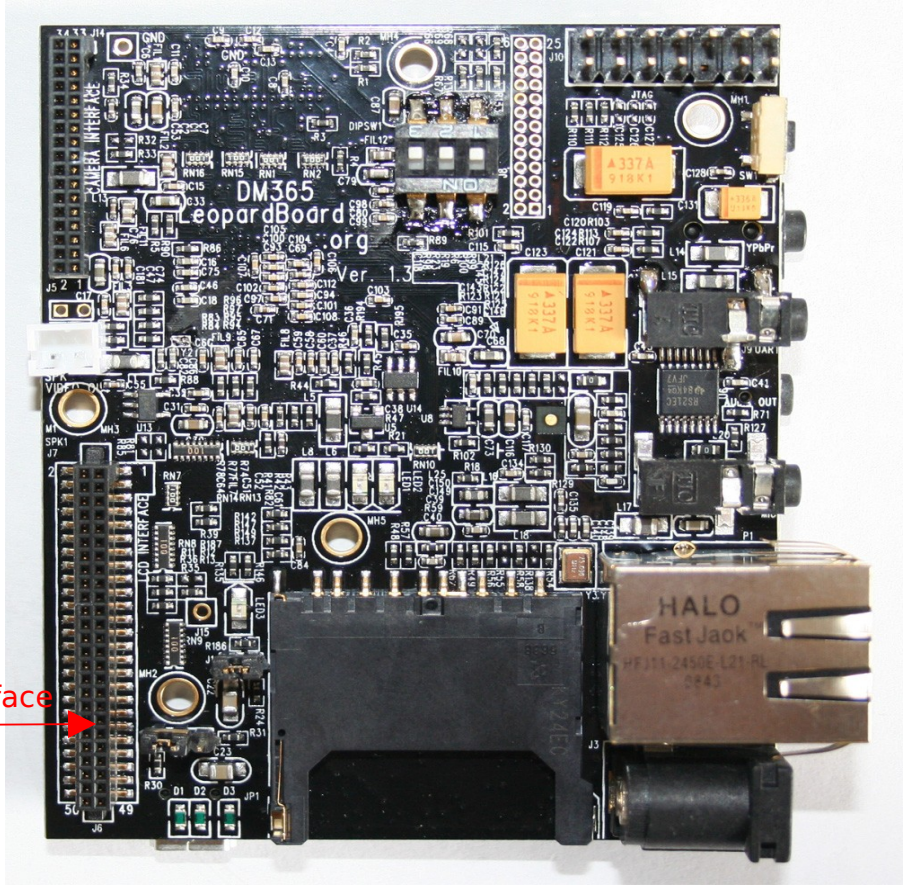


**Figure 41. LCD/DVI Interface**

LCD interface pin assignment, see Figure 42

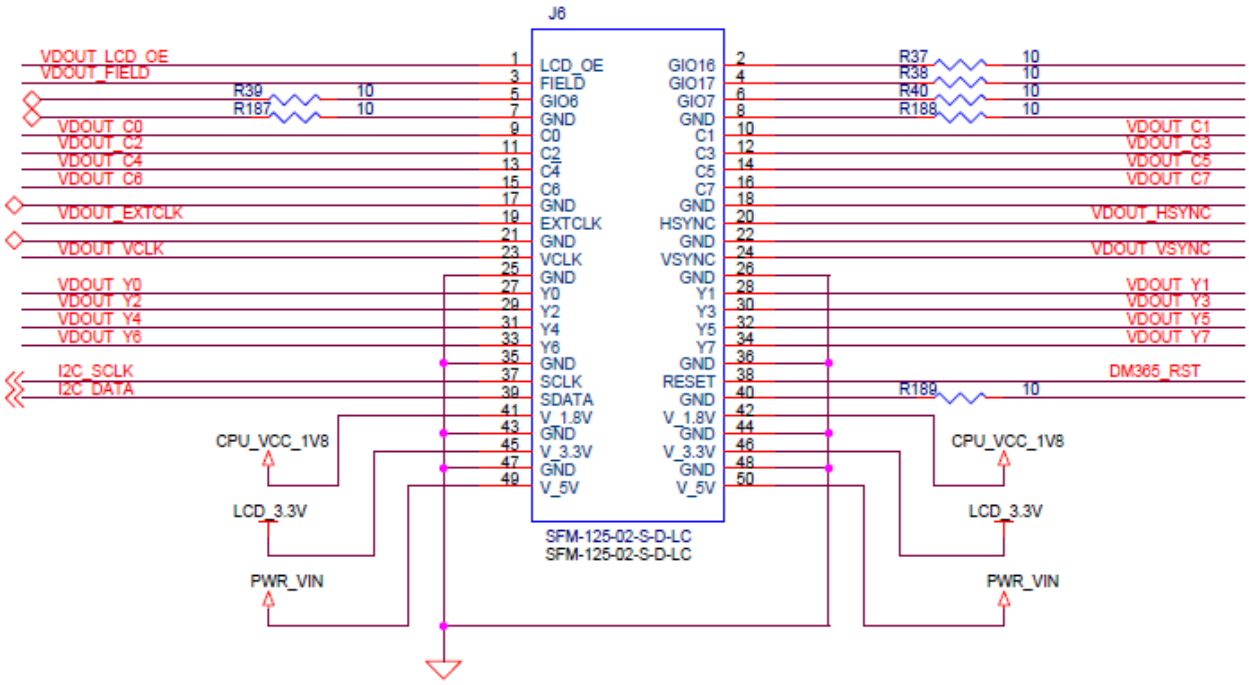


**Figure 42. Pin Assignment for LCD Interface**

## 2.19 Expansion Port

A 26-pin connector is provided as expansion port to support the following functions, see Figure 43.

- SD/MMC
- I2C
- UART
- McBSP
- GPIO
- 3.3V power supply.

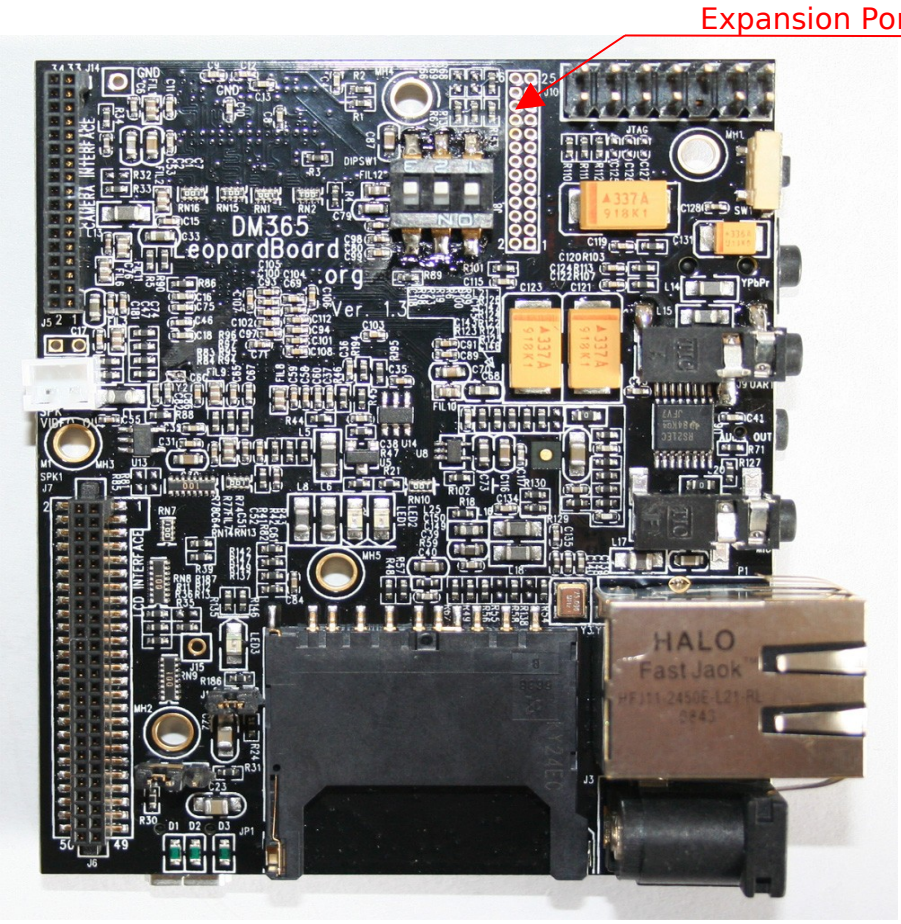


**Figure 43. Expansion Interface**

Expansion port pin assignment, see Figure 44.

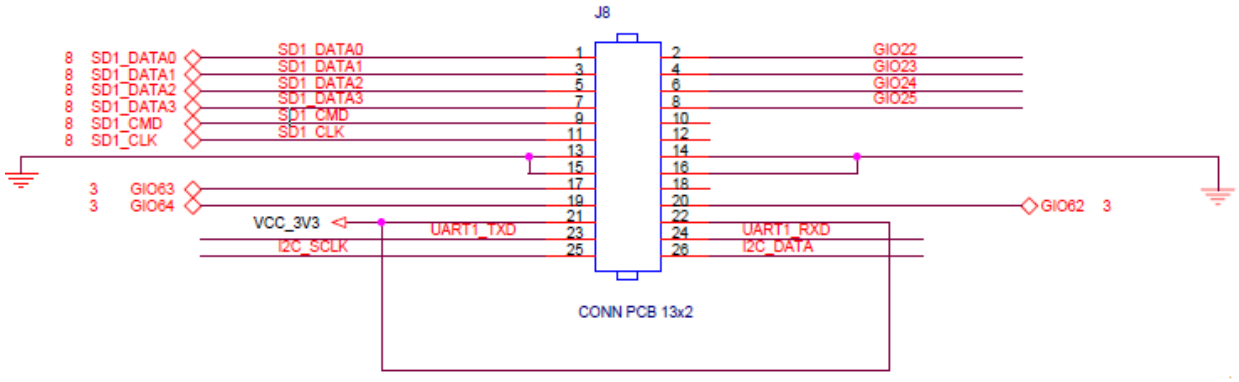


**Figure 44. Pin Assignment for Expansion port**

## 2.20 Reset Button

Reset button can reset board to power-up status. See Figure 45

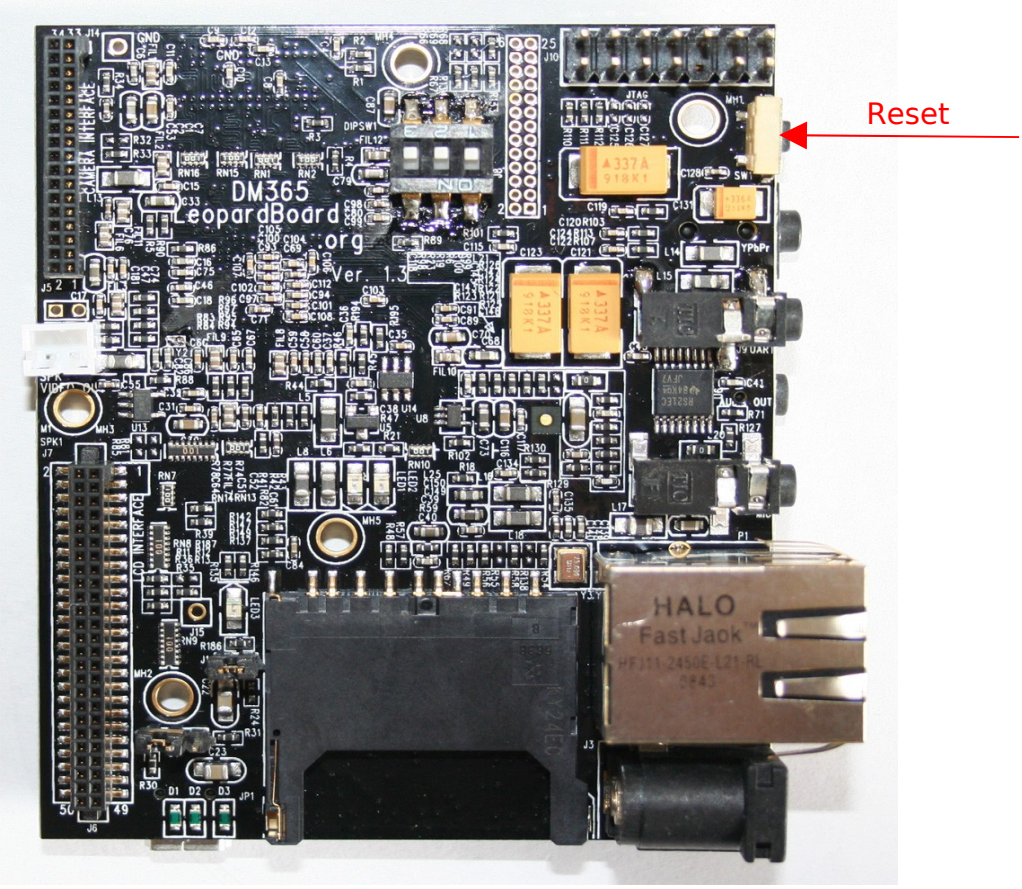


**Figure 45. Reset Button**

## 2.21 DIP Switch

Leopardboard 365 has included a DIP switch for boot up control. See **table 3** for boot control modes.

| EM_A13, #1 | EM_A12, #2 | EM_A11, #3 | BOOT MODE |
|---|---|---|---|
| 0 | 0 | 0 | Nand Boot Mode |
| 0 | 1 | 0 | SD Boot Mode |
| 0 | 1 | 1 | UART Boot Mode |
| 1 | 0 | 0 | USB Boot Mode |
| 1 | 1 | 0 | EMAC Boot Mode |

("0"= off, "1"= on)

**Figure 46 shows the DIP switch on Leopardboard 365**

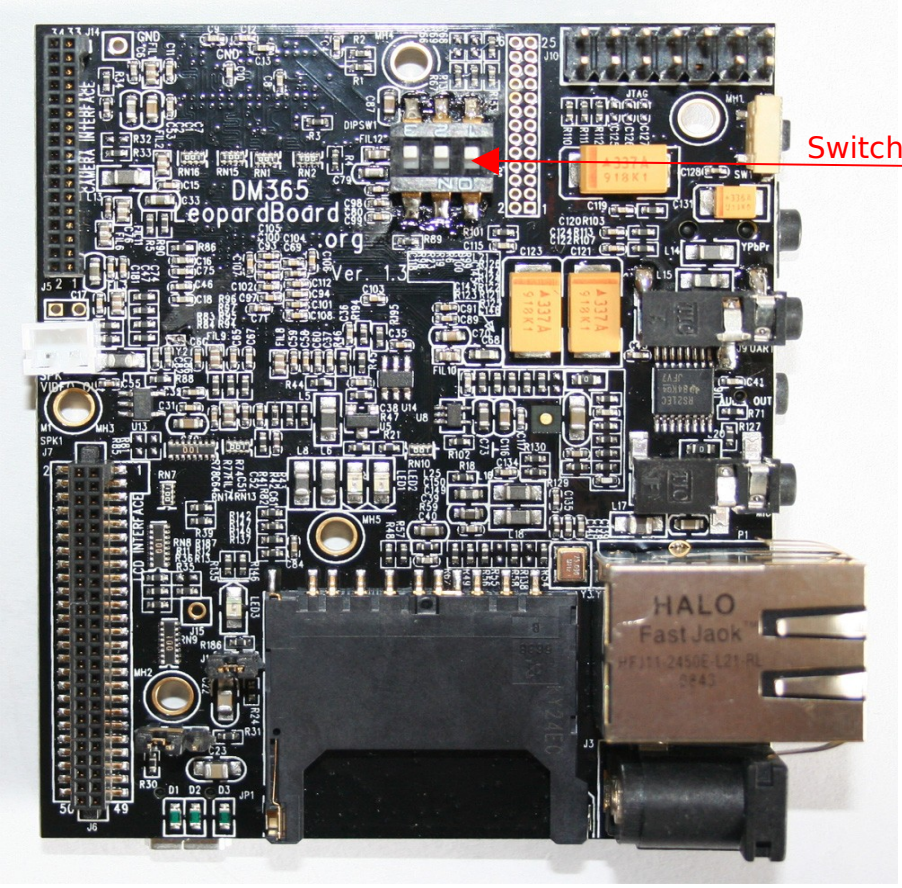


**Figure 46. DIP Switch**

**PCB Board Mechanical Specification**

| | |
|---|---|
| Board Size: | 3.0” x 2.5” |
| Max height: | 0.67” with RJ45 Connector |
| Layers: | 6 |
| Color: | Black |
| PCB thickness: | .062” |
| RoHS Compliant: | Yes |
| Weight: | 1.5 Oz |

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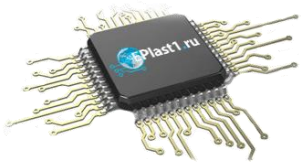


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