Samsung S3C6410 ARM11 Board

Hardware Reference Guide

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0.1. Introduction

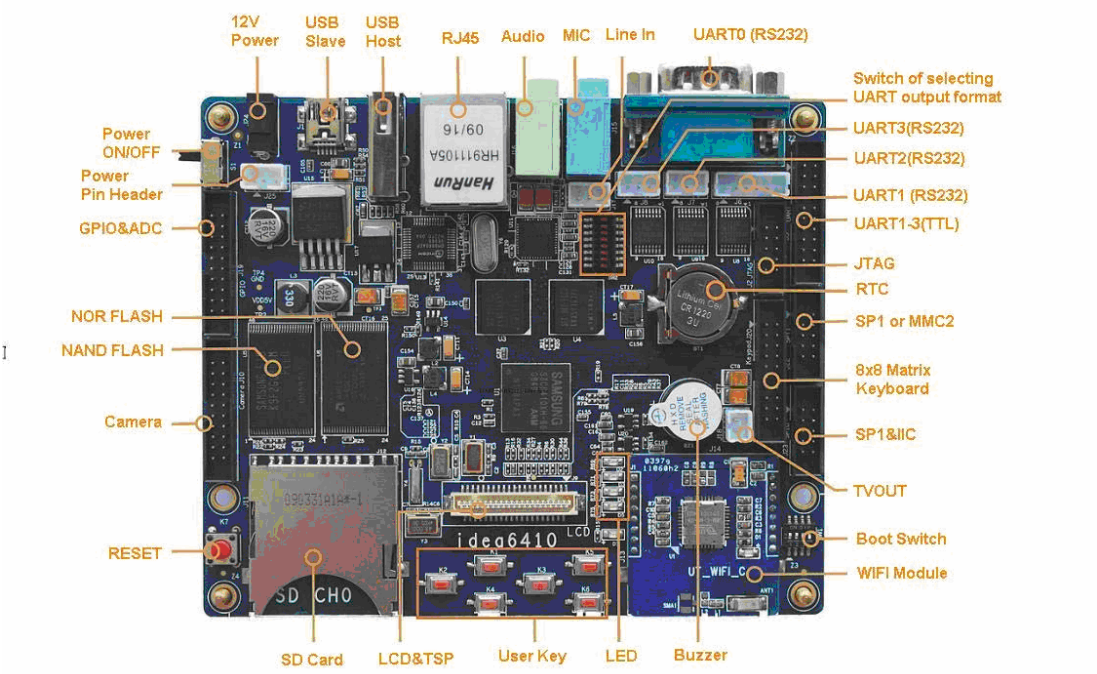


Figure 1.0 the picture of the Samsung S3C6410 ARM11 Board

0.1. About this Manual

This manual is intended to provide the user with an overview of the board and benefits, complete features specifications, and set up procedures. It contains important safety information as well.

0.2. Feedback and Update to this Manual

To help our customers make the most of our products, we are continually making additional and updated resources available on the Embest website (www.embedinfo.com).

These include manuals, application notes, programming examples, and updated software and hardware. Check in periodically to see what's new!

When we are prioritizing work on these updated resources, feedback from customers is the number one influence, If you have questions, comments, or concerns about your product or project, please no hesitate to contact us at support.en@embedinfo.com .

0.3. Limited Warranty

Embest warrants this product to be free of defects in material and workmanship for a period of one year from date of buy. During this warranty period Embest will repair or replace the defective unit in accordance with the following process:

A copy of the original invoice must be included when returning the defective unit to Embest. This limited warranty does not cover damages resulting from lighting or other power surges, misuse, abuse, abnormal conditions of operation, or attempts to alter or modify the function of the product.

This warranty is limited to the repair or replacement of the defective unit .In no event shall Embest be liable or responsible for any loss or damages, including but not limited to any lost profits, incidental or consequential damages, loss of business, or anticipatory profits arising from the use or inability to use this products.

Repairs make after the expiration of the warranty period are subject to a repair charge and the cost of return shipping. Please contact Embest to arrange for any repair service and to obtain repair charge information.

CONTENT

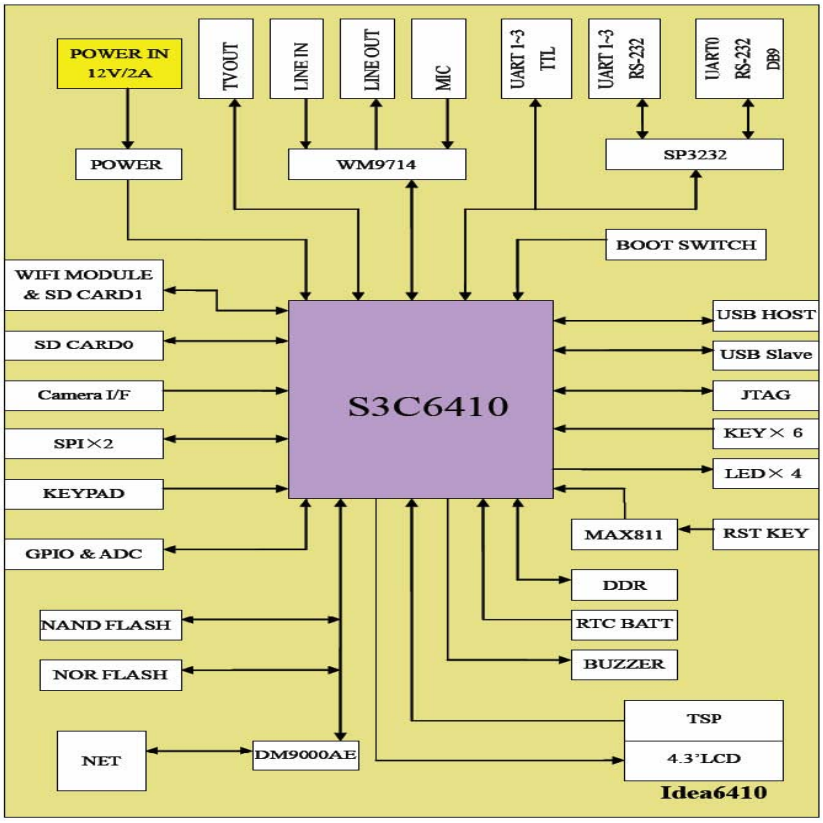
1. Overview

The S3C6410 Board is a compact full-featured Embedded Single Board Computer (SBC) based upon Samsung ARM11 S3C6410, designed specifically for Mobile Internet Device, Notebook, handheld/3G mobile implementations. Its functional contents are similar to the latest generation of Pocket PC's and smart phones. This computer allows easy embedded application development through PC-Compatible tools and methods, while ensuring in-field reliability and ruggedness for end-user systems. S3C6410 runs without fans or heat sinks in the temperature range of -20°C to +70°C. Other chip-level features include 4 UARTs, SPI, I2C, a real-time clock with a separate power domain, and NAND Flash and DDR memory controllers. These features make the devices particularly suitable for automotive and industrial control applications as well as medical systems. In addition, the board supports Windows Embedded CE 6.0, Linux2.6, Android and Ubuntu OS.

1.1. Highlights

- Rugged Single Board Computer(120mmx58mm) achieved through modern SMD technology
- Improved interference safety achieved through multi-layer PCB technology and dedicated ground pins
- Controller signals and ports extend to connectors aligning two sides of the board
- Four Ready-to-Run software package: WinCE6.0, Linux2.6.24, Android and Ubuntu
- Working temperature: -20°C to 70°C
- Processor: Samsung S3C6410, ARM1176JZF-S, up to 667MHz.
- Power supply: +12V
- 128MB Mobile DDR SDRAM, 133MHz, 32bit, Samsung K4X51163PC
- 256MB NAND Flash, 8bit, Samsung K2F2G08
- 2M Bytes NOR Flash, AMD AM29LV160DB
- SDIO WIFI Module, supporting IEEE802.11b/g
- LCD/Touch Screen interface. Supporting 3.5 inch TFT LCD, 4.3 inch TFT LCD and 7 inch TFT LCD.
- Many modules are available for your choice- GPS, WIFI, Camera, USB HUB+4x4 Matrix Keyboard.
- 24 GPIO, ADC, SPI,IIC and MMC connectors
- One audio input interface (3.5mm audio jack)
- One 2-channel audio output interface (3.5mm audio jack)
- One 100M Ethernet interface (RJ45)
- One USB2.0 Device port (Mini USB type interface)
- Four serial ports (Two are five-wire RS-232 DB9 interface, another two are three-wire TTL serial port led out from a 20-pin expansion connector)
- SD/MMC interface (supports 3.3V and 1.8V logic voltage)
- Camera interface (10x2 pins header, supporting the mode of ITU-R 601/656 8bit)
- One 5x2 pins JTAG interface
- Seven buttons (Reset, Boot, User defined, On/Off)
- TVOUT

1.2. S3C6410 Block Diagram



Figuer1.1 block diagram of the board

2. S3C6410 Power design

2.1. Power Supply for S3C6410 Board

2.1.1. Power Supply ways

The S3C6410 board power design adopts distributed fabric, adopting absolute power chip to power supply respective for S3C6410 and peripheral devices.

The main chip S3C6410 runs on frequency at 533MHz, and the CPU board is supplying power for CPU with 1.1V ARM Kernel power VDD_ARM, 1.3V PLL-VCC and startup power of the chip internal logic power VDD_xPLL and VDD_INT ,1.2V startup power VDD_Alive, 1.8V DDR memory VDD_MEM, 3.3V I/O and the other peripheral devices.

There are two ways for power supply for this S3C6410 Single Board Computer.

(1). Using Power Adapter through mini DC_IN connector J24 to send 12V/2A to the board

(2). Using Battery 5V/3A through connector J25 to power supply.

Below picture-2 shows the two connectors:

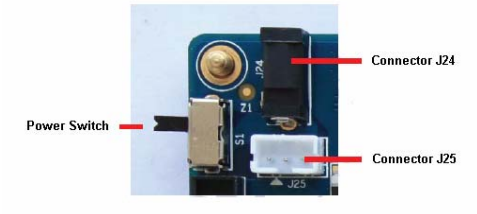


Figure 2.0 power supply ways

2.1.2 The Schematic drawing of power input

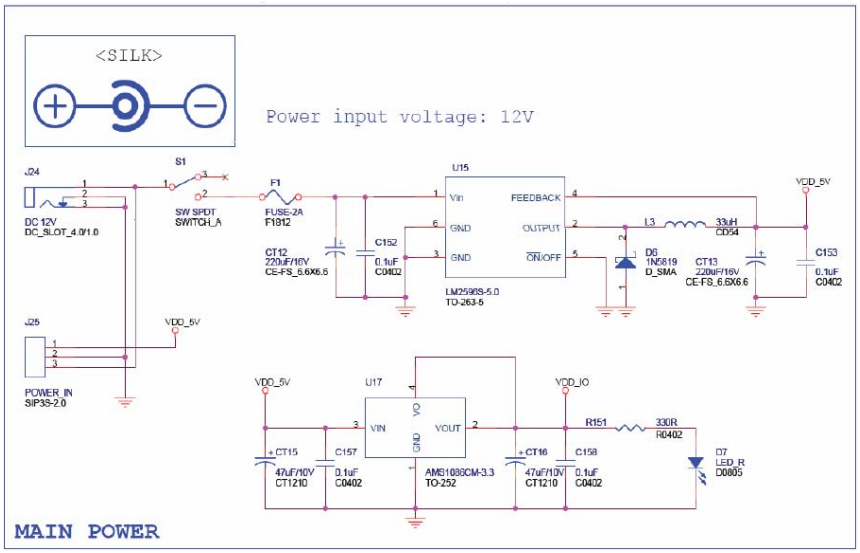


Figure2.1 the schematic drawing of power input

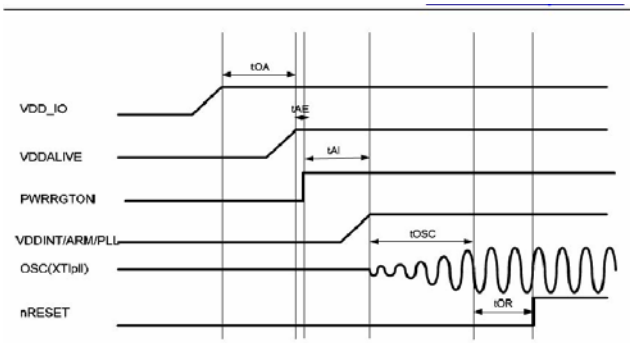
2.1.3. Voltage value on circuit dot

- VDD_5V: 5V
- VDD_IO: 3.3V
- VDD_OTG: 3.3V
- VDD_OTGI: 1.2V
- VDD_Alive: 1.2V
- VDD_INT: 1.3V
- VDD_ARM: 1.2V

- VDD_RTC: 3V
- VDD_ADC: 3.3V
- VDD_MDDR: 1.8V
- VDD_AC97:3.3V
- VDD_WIFI: 3.3V

2.2. Power electrical characteristics and power time sequence of S3C6410

Parameter	Symbol		Min	Typ	Max	Unit
DC Supply Voltage for Alive Block	VDDALIVE		0.95	1.2	1.25	
DC Supply Voltage for Core Block	VDDAPLL VDDMPLL VDDEPLL		0.95	1.2	1.25	
	66MHz[1]	VDDINT	TBD	TBD	TBD	
	133MHz[1]	VDDINT	1.15	1.2	1.25	
	266MHz[1]	VDDARM	TBD	TBD	TBD	
	400MHz[1]	VDDARM	TBD	TBD	TBD	
	533MHz[1]	VDDARM	1.15	1.2	1.25	
	634MHz[1]	VDDARM	TBD	TBD	TBD	
DC Supply Voltage for Memory Interface0 (NOR/NAND/OneNAND/CF)	VDDMEM0		1.7	1.8~3.3	3.6	
DC Supply Voltage for Memory Interface1 (DRAM)	VDDMEM1		1.7	1.8/2.5	2.7	
DC Supply Voltage for I/O Block	VDDMMC/VDDHI/VDDLCD/VDDPCM/VDDEXT/VDDSYS		1.7	1.8/2.5/3.3	3.6	
DC Supply Voltage for RTC	VDDRTC		1.7	1.8/2.5/3.3	3.6	
DC Supply Voltage for ADC	VDDADC		3.0	3.3	3.6	
DC Supply Voltage for DAC	VDDDAC		3.0	3.3	3.6	
DC Supply Voltage for USB OTG Phy 3.3V	VDDOTG		3.0	3.3	3.6	
DC Supply Voltage for USB OTG Internal	VDDOTGI		1.15	1.2	1.25	
DC Supply Voltage for USB Host	VDDUH		3.0	3.3	3.6	
Operating Temperature	TA		Extended	-20 to 70		°C
	TA		Industrial	-40 to 85		°C



Symbol	Description	Min	Typical	Max	Units
tOA	VDDpadIO to VDDALIVE	0			ms
tAI	VDDALIVE to VDDINT/VDDARM	1			us
tAE	VDDARM to PWR_EN(PWRRGTON)	1		10	ns
tOSC	VDDLOGIC/VDDARM to Oscillator stabilization	10			cycle
tOR	Oscillator stabilization to nRESET & nTRST high	1			us

2.3. Block diagram of Power Supply of the board

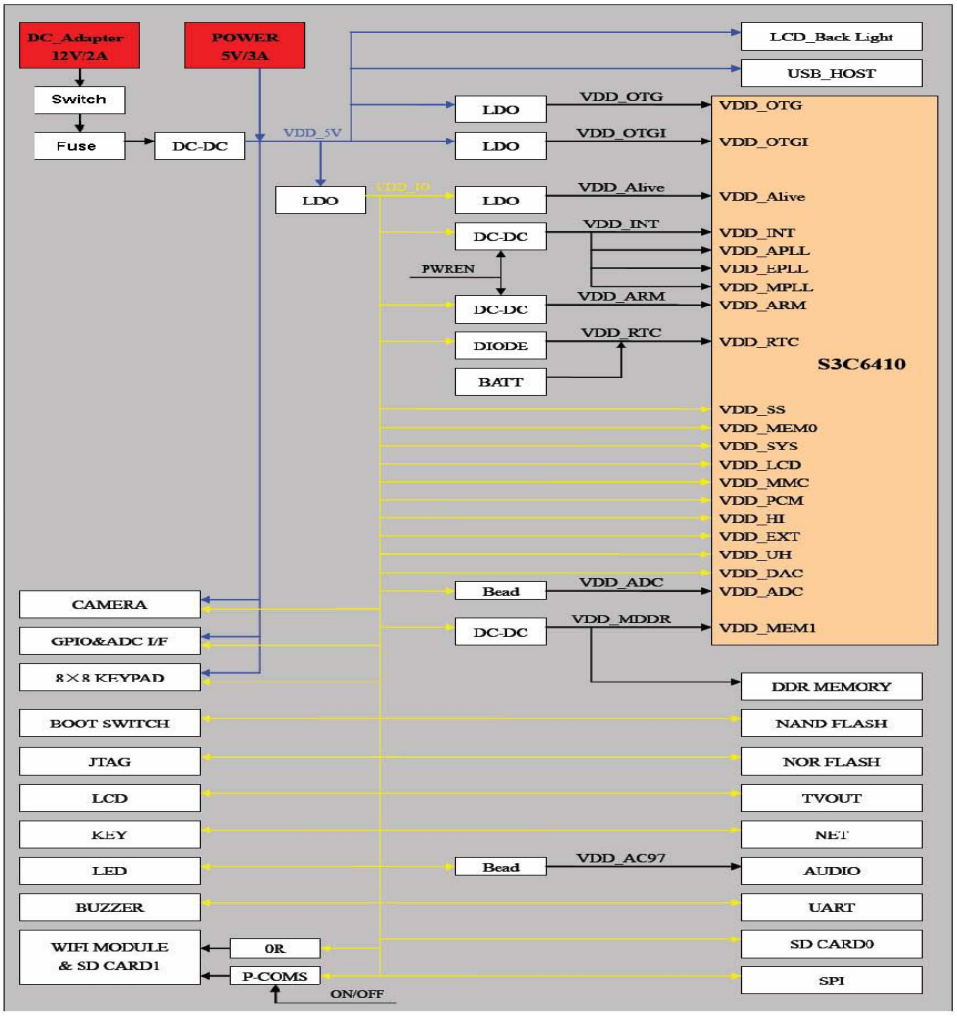


Figure2.2 power supply block diagram of the board

2.4. Bootloader startup configuration mode

The main chip S3C6410 supports many kinds of startup mode such as Nand Flash, Nor Flash, OneNand and SD Card and so on. It selects startup device and mode through configuring different pins' status when the system started. Below figure 2.5 shows the startup mode of S3C6410.

XSELNAND	ON[4:1]	EINT[15:13]	Boo-up Device	Note
1	0000	XXX	Nand Flash	512k page size, addressing cycle is 3 clock
1	0001	XXX	Nand Flash	512k page size, addressing cycle is 4 clock
1	0010	XXX	Nand Flash	2048k page size, addressing cycle is 4 clock
1	0011	XXX	Nand Flash	2048k page size, addressing cycle is 5 clock
X	0100	XXX	SROM(8bit)	-
X	0101	XXX	SROM(16bit)	-
0	0110	XXX	OneNand	Can not use Nand Flash
X	0111	XXX	Modem	SCn2 can not be connected with SROM

X	1111	000	Internal ROM	SD access0	-
X	1111	001	Internal ROM	OneNand	-
1	1111	010	Internal ROM	Nand Flash	512k page size, addressing cycle is 3 clock
1	1111	011	Internal ROM	Nand Flash	512k page size, addressing cycle is 4 clock
1	1111	100	Internal ROM	Nand Flash	2048k page size, addressing cycle is 4 clock
1	1111	101	Internal ROM	Nand Flash	2048k page size, addressing cycle is 5 clock
1	1111	110	Internal ROM	Nand Flash	4096k page size, addressing cycle is 5 clock
X	1111	111	Internal ROM	SD access1	-

Figure2.3

The S3C6410 Board Supports NOR Flash, Nand Flash, SD Card startup mode, please see the blue part of above picture. Also the picture-2.6 is a part of S3C6410 board's startup mode.

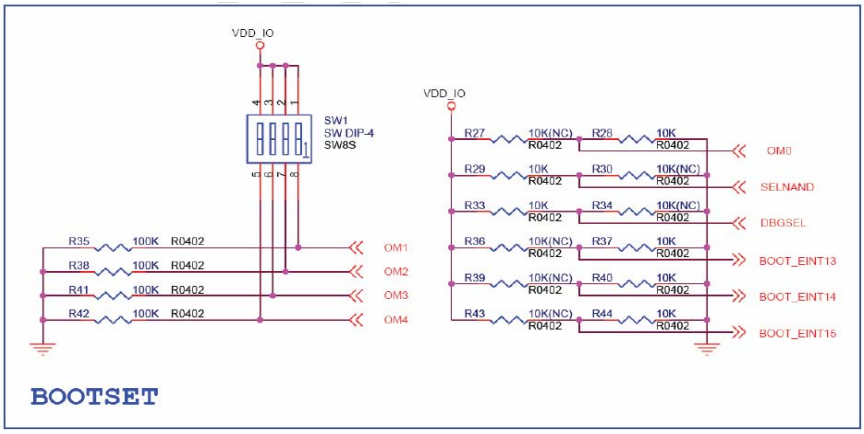


Figure2.4

On the above Figure2.4, "OM0" is chip S3C6410 clock source select signal. It selects "XTIpll ", when "OM0" is "0", it select "EXTCLK" when "OM0" is "1". The IDEA6410 uses "XTIpll".

"SELNAND" is a signal of selecting memory type, it is high level when selects NAND Flash, it is low level when selects ONENAND. S3C6410 Board uses NAND Flash.

EINT13-EINT15 are device selected pins of IROM startup mode, when adopts IROM startup mode, the main chip S3C6410 runs settled program in advance then reads EINT15,EINT14,EINT13 three pins' status with different configuration to select startup device, the detailed configuration please see figure-2.5.

It is IROM startup mode when user selected SD Card as startup device. At this mode, EINT15, EINT14, EINT13 are low level. So the user will see on the S3C6410 board, those signals EINT15, EINT14, EINT13 are directly connected ground.

DBGSEL is JTAG interface call select signal, about it detail, please see the chapter 4.3.

On S3C6410 Single Board Computer, the three pins EINT13-15 had been set into low level, please select startup mode by configuring OM1-OM4 and SELNAND, the switch SW1 moves to subject place, please see below

figure2.5 of SW1 configuration.

Ports	OM1	OM2	OM3	OM4
SW1's Position	1	2	3	4
Nor Flash boot-up	1	0	1	0
Nand Flash boot-up	1	1	0	0
SD boot-up	1	1	1	1

Figure2.5

Note: a. "1" is SW1 ON, "0" is SW1 OFF, "X" is high level or low level.
b. The default startup mode of IDEA6410 is NAND Flash.

Below is the Figure2.6 about SW1.

Figure2.6 SW1

OM0 is chip S3C6410 clock source select signal. It selects XTIpll when OM0 is "o", it selects EXTCLK when OM0 is "1". The IDEA6410 uses XTIpll.

3. S3C6410 Hardware Design and interfaces description

3.1. Nand Flash

S3C6410 Single Board Computer selected SLC Nand FLASH K9F2G08 from Samsung, its size is 256M Bytes, mainly for storage Kernel, application, file system and user data.

Additionally, may parts that are footprint and functionally compatible with the Nand Flash devices listed above may also be used with the S3C6410 Board.

As of the printing of this manual, these NAND Flash devices generally have a life expectancy of at least 100,000 erase/program cycles and a data retention rate of 10 years.

Nand FLASH is a startup device, when it startup, the main chip S3C6410 automatically copy the former 8K bites code in Nand Flash to the chip's internal Stepping Stone room for running. After initialization configuration, the chip jumps to start address of Kernel to run the OS. Below picture shows the schematic drawing of Nand Flash:

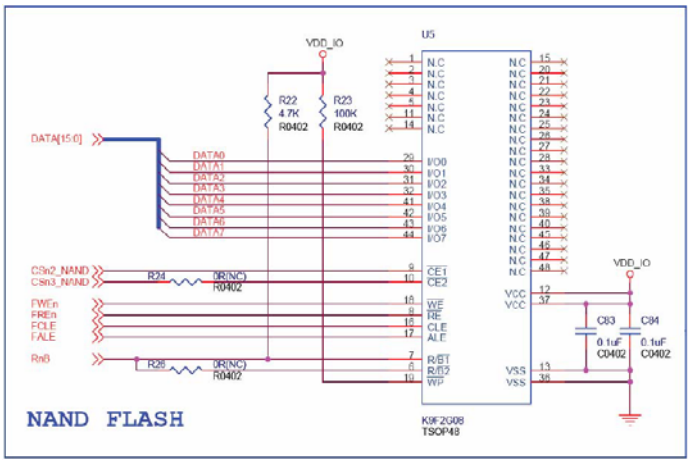


Figure3.0

3.2. DDR RAM

The S3C6410 board adopts two Samsung K4X51163PC 64M Bytes Mobile DDR RAM with 266MHz. They are small BGA package in order to save the room of the board, also is to use same length circuit line on the PCB for guaranteeing the board running with high speed and stably.

3.3. Nor Flash

S3C6410 Board adopts ARM AM29LV160DB Nor Flash, the chip S3C6410 maximum supports 27 pieces address signals A0-A26, in which A20-A26 is reused with DDR data signals D20-D26. As S3C6410 Board adopted 32bit DDR RAM, so there are only 19 lines A1-A19 for NOR Flash to use. Nor Flash addressing range is 1M Bytes.

Nor Flash can be configured as startup device, it adopts 16-bit SROM startup mode.

Below picture shows the schematic drawing of NOR Flash:

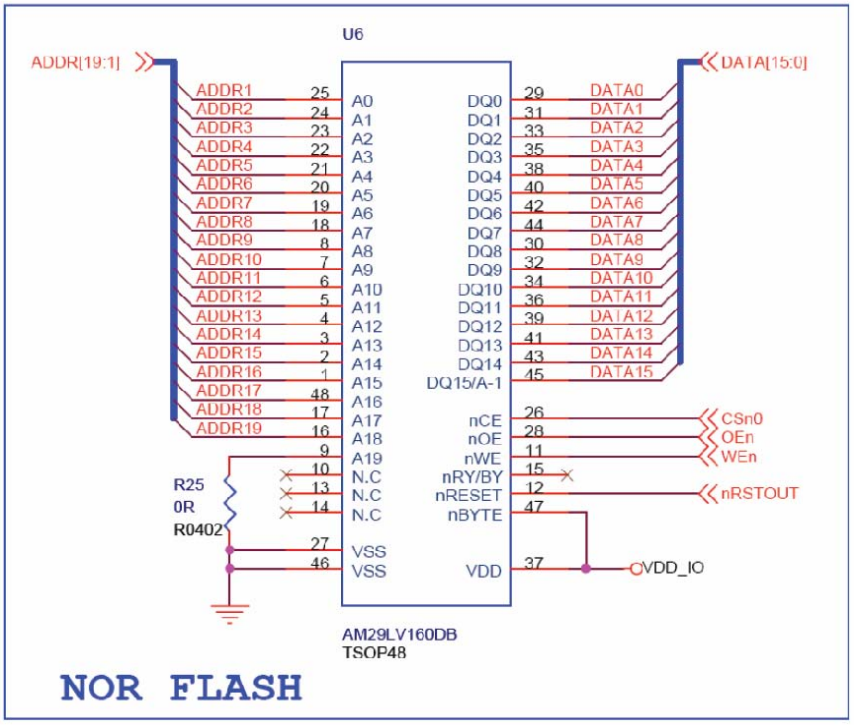


Figure3.1 the schematic drawing of NOR Flash

3.4. Serial Interface

There are four Serial interfaces, UART0, UART1 is 5 lines, while UART2, UART3 is 3 lines.

The board uses three pieces SP3232 serial interface chip to change the four serial interfaces to RS232 level. The user can use switch SW2 to change the output of serial interface into RS232 or TTL level. There is one piece of standard DB9 port at connector J4, which is specially design for debugging and printing debugging message. Below picture shows circuit of UART0

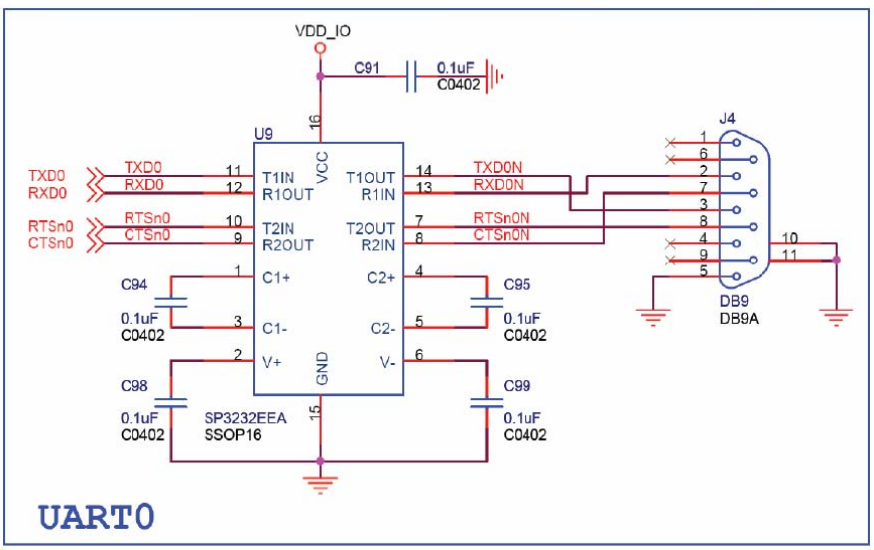


Figure3.2 the circuit of UART0

UART1, UART2 or UART3 can be set output into RS232 or TTL by adjusting switch SW2. The pin header J6, J7, J8 is corresponding to UART1, UART2, UART3 for selecting RS232 output, pin header J5 is TTL output for UART1, UART2, UART3. Below picture shows those pin header connectors.

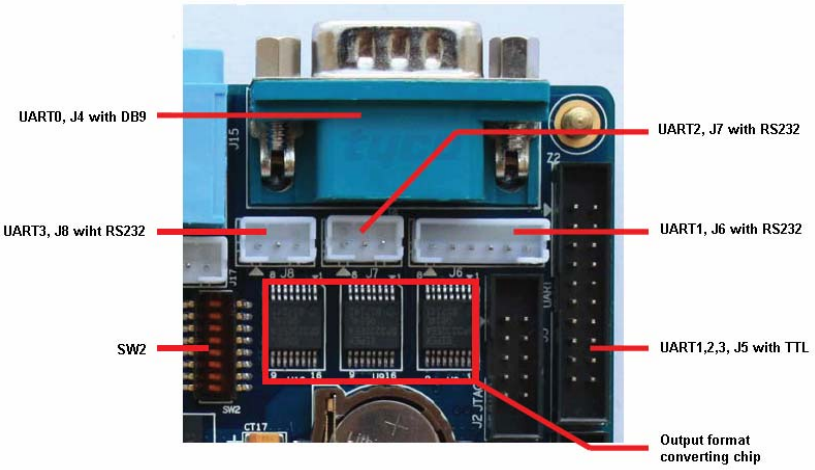


Figure3.3 UART Connectors

Below picture is the circuit drawing of UART1, UAR2 and UART3:

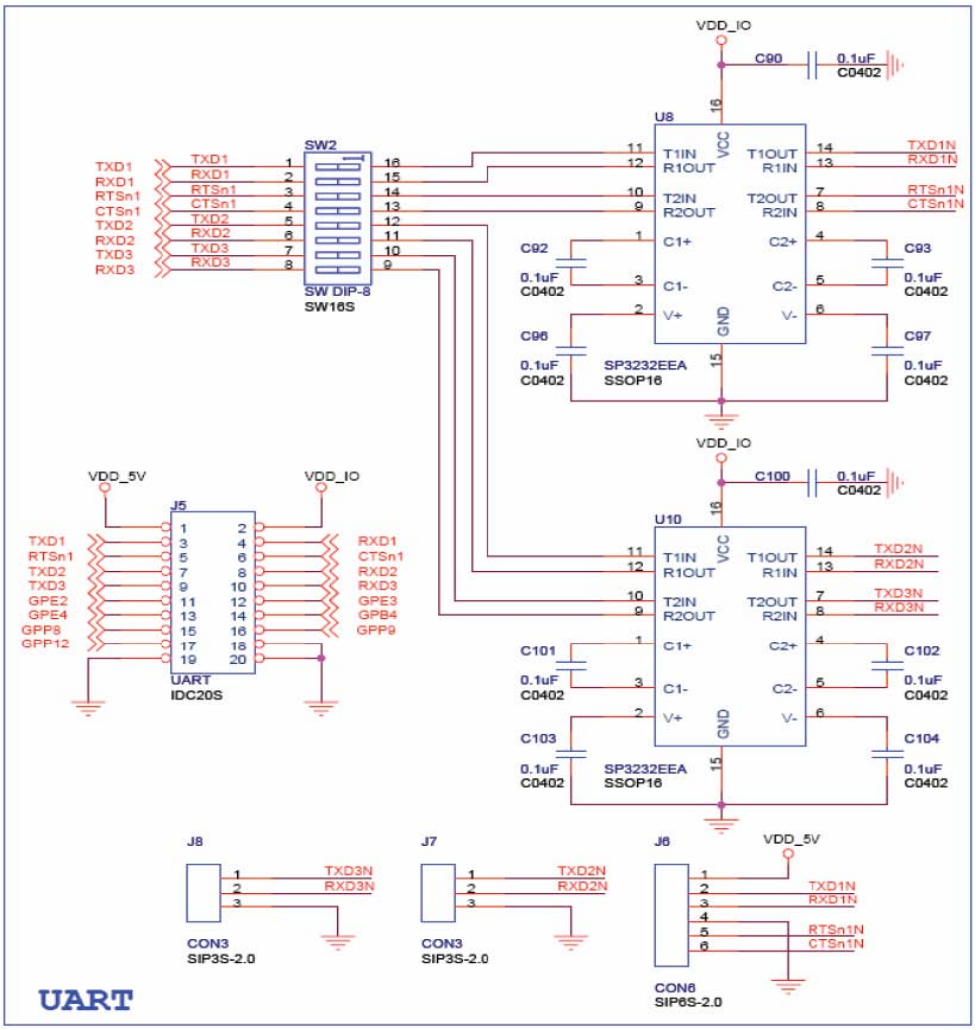


Figure3.4 the circuit drawing of UART1, UAR2, UART3

The states of Serial interface output controlled switch SW2, please see below figure:

SW2's corresponding Place	1-4 bit	5-6 bit	7-8 bit

UART1 TTL output	0	x	x
UART1 RS232 output	1	x	x
UART2 TTL output	x	0	x
UART2 RS232 output	x	1	x
UART3 TTL output	x	x	0
UART3 RS232 output	x	x	1

Note: It is “1” when SW2 is put on “ON”, it is “0” when SW2 is put on “OFF”, “x” means that the output can not be fixed.

4. Interface

4.1. USB Host

USB Host interface supports USB2.0 Full speed and its port is A type/
The port supports U-Disk, USB Keyboard, USB Portal Disc, USB Mouse.
Below is its circuit drawing of USB Host.

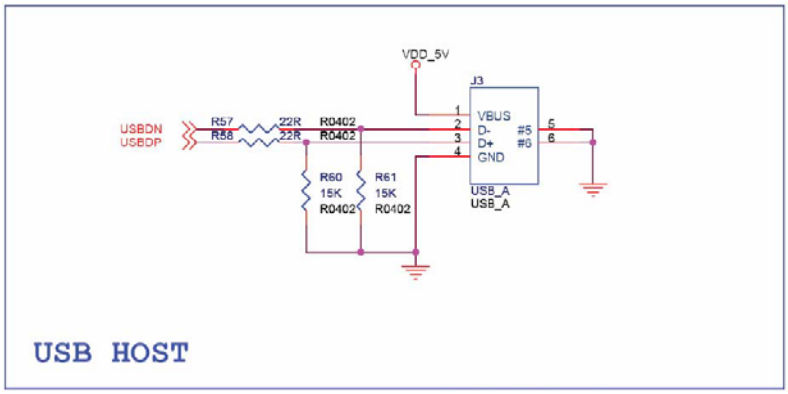


Figure4.0 the circuit drawing of USB Host

4.2. USB OTG

The controller supports the On-The-Go (OTG) feature. The Universal Serial Bus OTG is a device capable to initiate the session, control the connection and exchange Host/Peripheral roles between each other.
USB OTG supports USB 2.0 protocol; it supports High-speed (480Mbps), Full speed (12Mbps), low speed (1.5Mbps) data rates. The S3C6410 Board default runs on high speed and slave mode for conveniently connecting with PC. It can use USB OTG to download program or application when the user in the development. The USB OTG port type is Mini A/B, below picture is its circuit drawing.

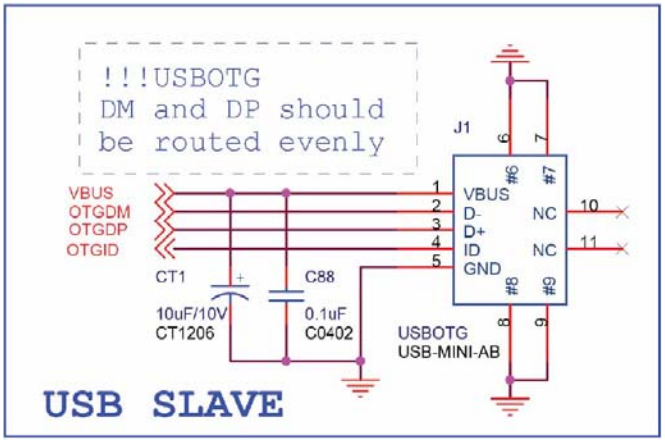
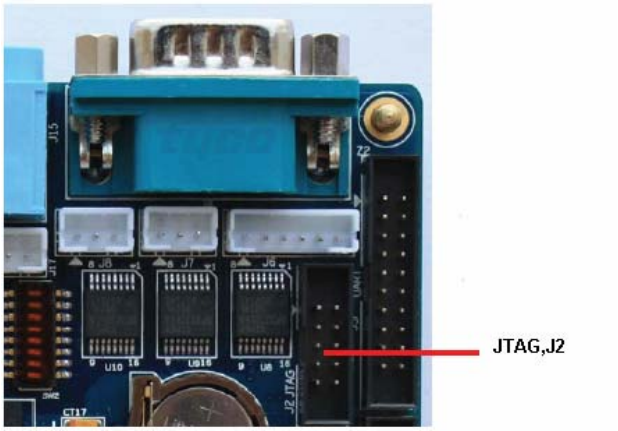


Figure4.1 the circuit drawing of USB Slave

4.3. JTAG

The S3C6410 Board is equipped with a JTAG interface for downloading program code into the external flash, internal controller RAM or for debugging programs currently executing. The JTAG interface extends out to a 5*2 2.0mm pitch pin header J2. Via configuring the signal DBGSEL the user can select to operate external Flash or internal controller RAM, below is the detail configuration of signal DBGSEL.

- When DBGSEL is set as high level, JTAG connects internal controller RAM and can call on the address of internal controller SRAM.
- When DBGSEL is set as low level, JTAG connects external flash for debugging programs.



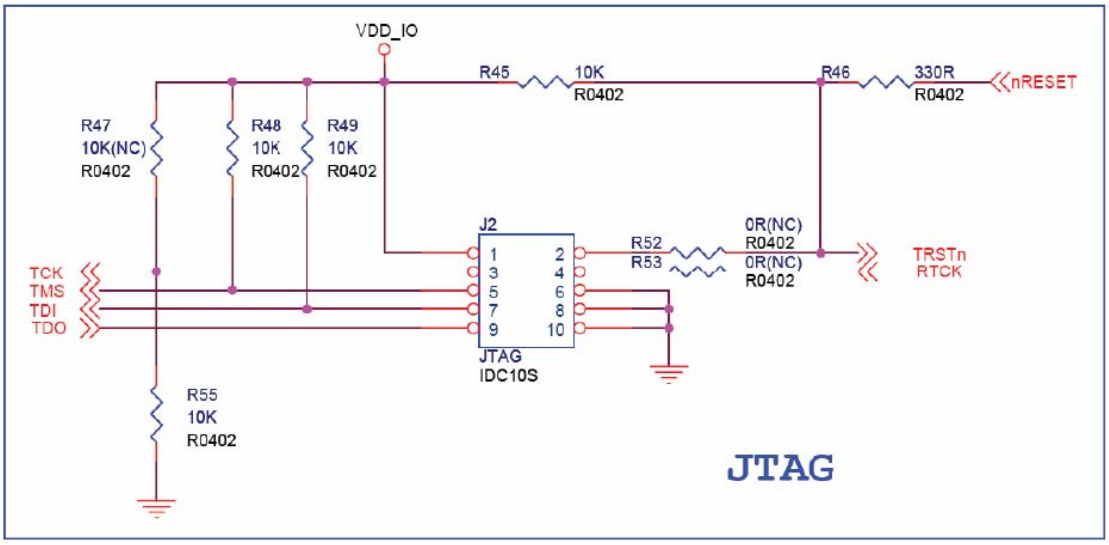


Figure4.2 the picture and circuit drawing of the JTAG Connector

4.4. SD Card

SD Card port J12 supports SD Memory protocol 2.0 and SDIO protocol 1.0. As SD Memory it can support up to 8G SD card, as SDIO it can support WIFI, GPS Module.

Also the SD Card can be taken as startup device for easily mass production and software update. About detail configuration please see the chapter 3.5.

Below picture shows the circuit drawing of SD Card.

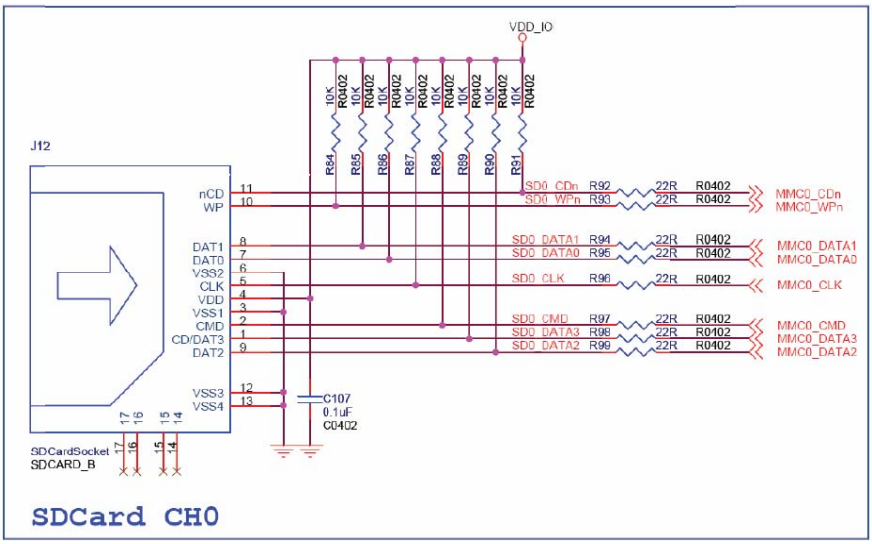


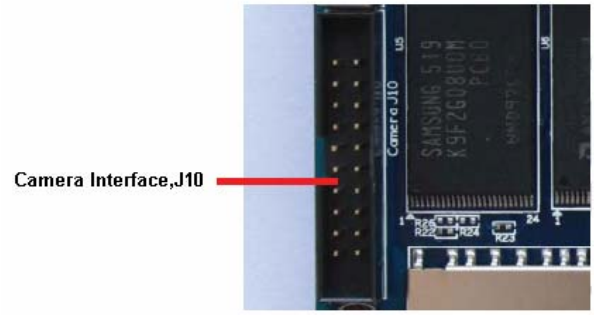
Figure4.3 the circuit drawing of SD Card

4.5. Camera interfaces

The camera interface supports 8bit ITU-R BT 601/656 mode and resolution up to 4096x4096 dots. The camera interface is a kind of 10*2 pin header connector at J10. The interface not only has camera signal led out from CPU controlled but also has been added signal IIC and CAM_PD/GPP14 (GPIO). In normally the camera device is set by IIC, but we added CAM_PD/GPP14 to protect IIC clashed with other external devices, once this case happens, the CAM_PD/GPP14 (GPIO) can replace IIC. We also added CAM_PD/GPP14 for camera device power management like power off, power save management and so on.

Embest developed a camera module which can directly connect with the board, and its resolution up to 1.3M pixels. More information about the Module, please refer to chapter 5.3.

Below pictures are about Camera interface:



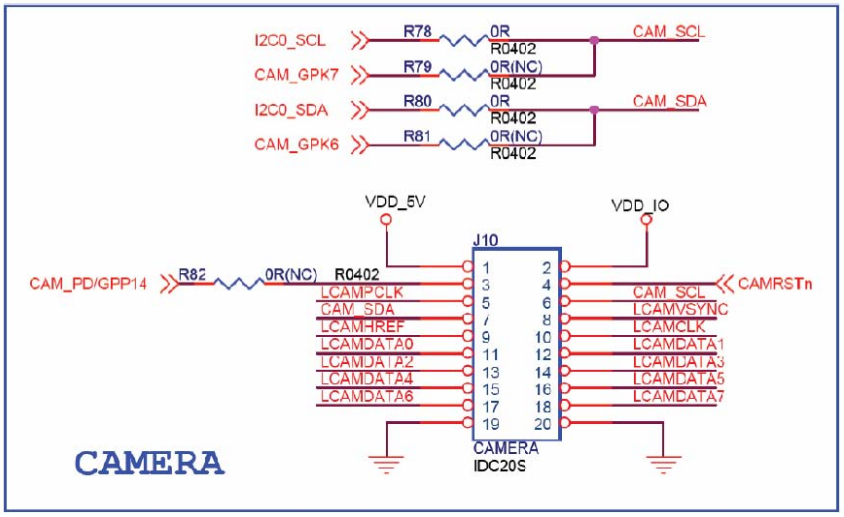


Figure4.4 the picture and circuit drawing of the camera interface

4.6. TFT LCD and Touch Screen interface

The default package for the S3C6410 Single Board Computer contains a piece of LCD Module, the Module is made from one piece of 4.3inch TFT LCD which spec is Innolux AT043TN24, one piece of Touch Screen and one piece of converter board. The module is connected with the board via a 41pin 0.5mm pitch FPC cable at connector J9. The connector contains 2 GPIO and 1 PWM, S3C6410 Board uses PWM to control Black-light, but the 2 GPIO weren't used, the user can use 2 GPIO to reset, power management and many other functions. Below pictures are about LCD and TC connector.

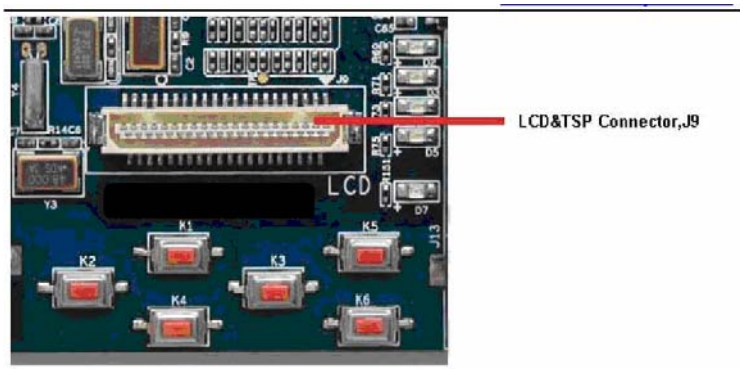


Figure4.5.1 the picture of the LCD and TC connector

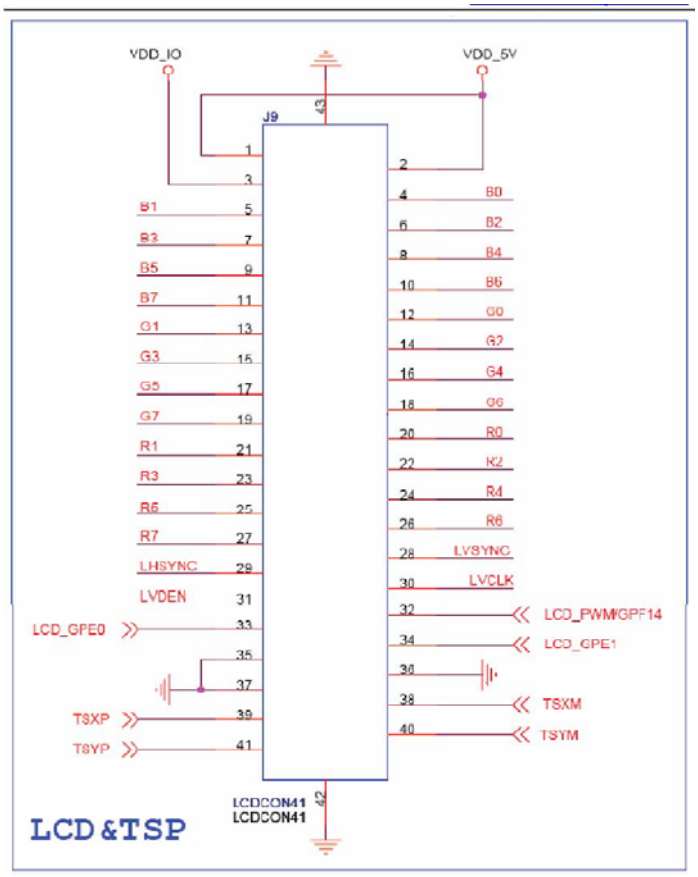
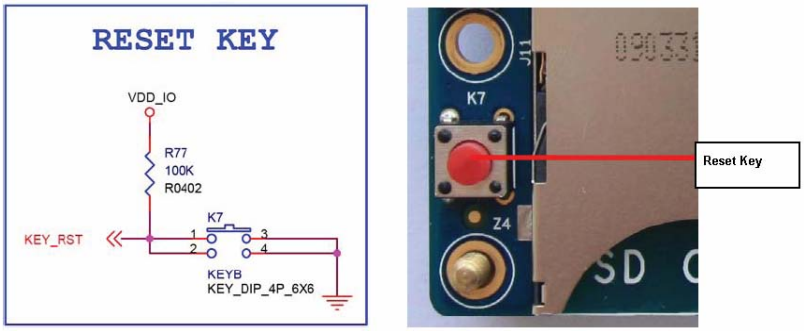


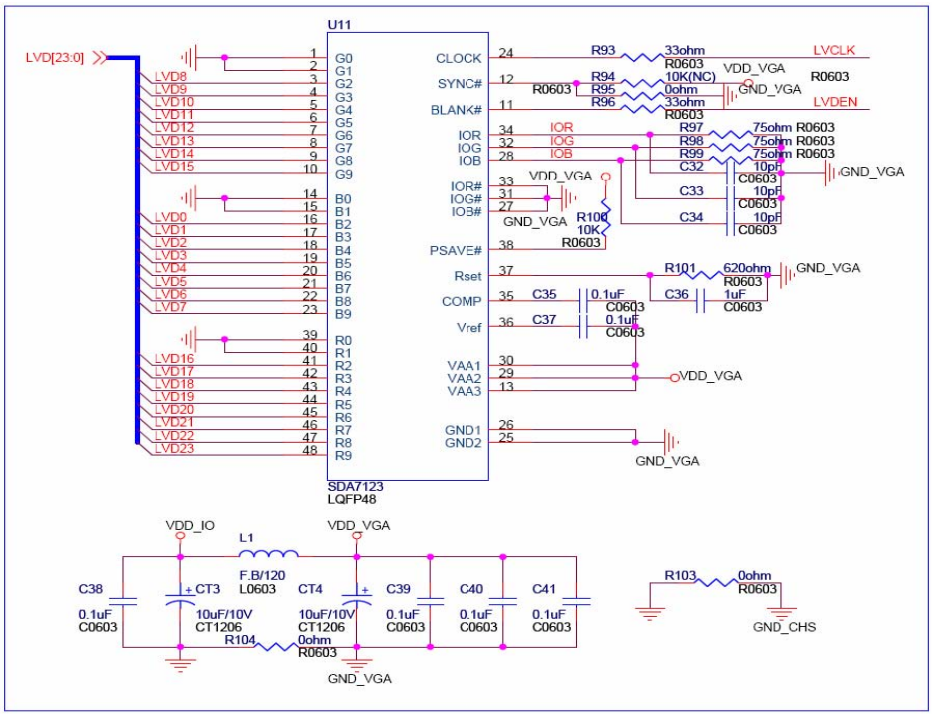
Figure4.5.2 the circuit drawing of the LCD and TC connector

4.7. Reset key

S3C6410 Board adopts reset chip MAX811T.

Below pictures are circuit drawing of reset.





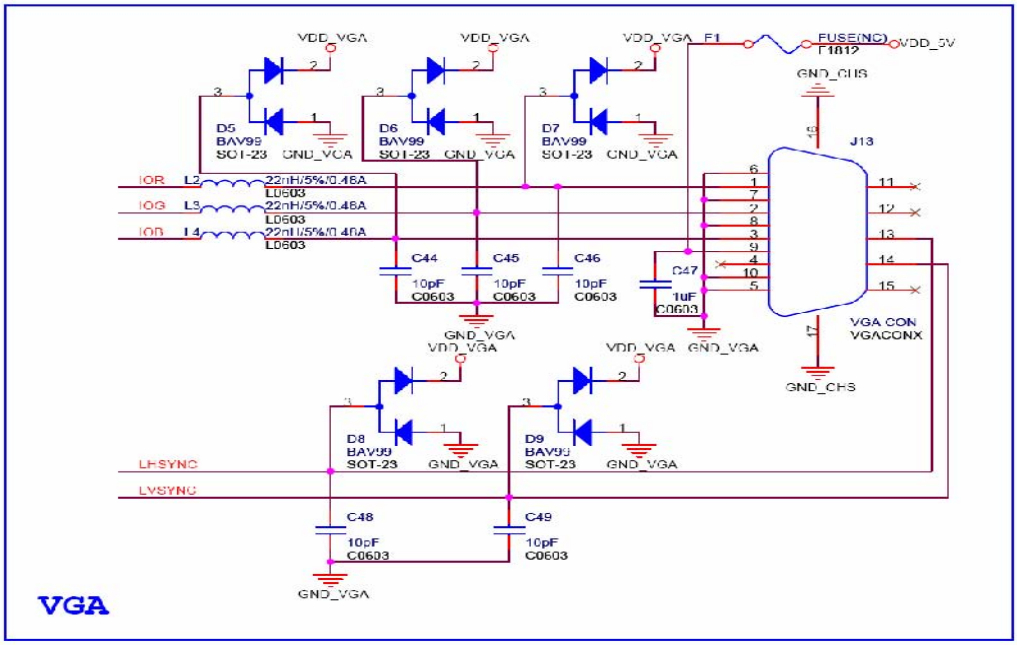
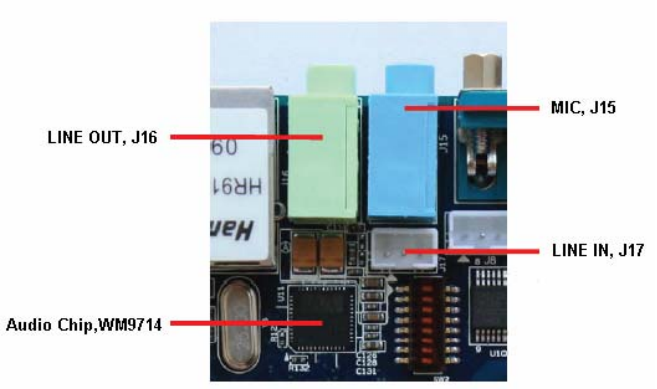


Figure4.6 the picture and circuit drawing of the Reset button

4.8. Audio interface

S3C6410 Board adopts internal controller AC97 BUS to connect external audio chip WM9714. The board has connectors Line out(J16), Line in(J17) and MIC in(J15).

Below pictures are about Audio interface.



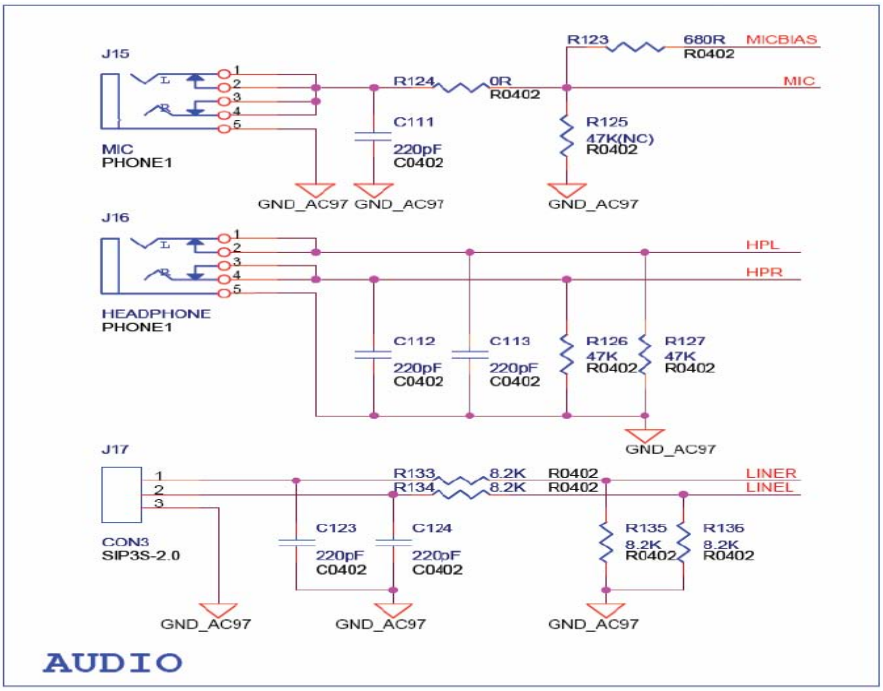


Figure4.7 the picture and circuit drawing of the Audio jack

4.9. Buzzer

S3C6410 Board has one piece of DC Buzzer. It adopts NPN dynatron SS8050 to amplify the driver current for buzzer. The buzzer is controlled by signal PWM1_GDF15.

Below is circuit drawing about Buzzer:

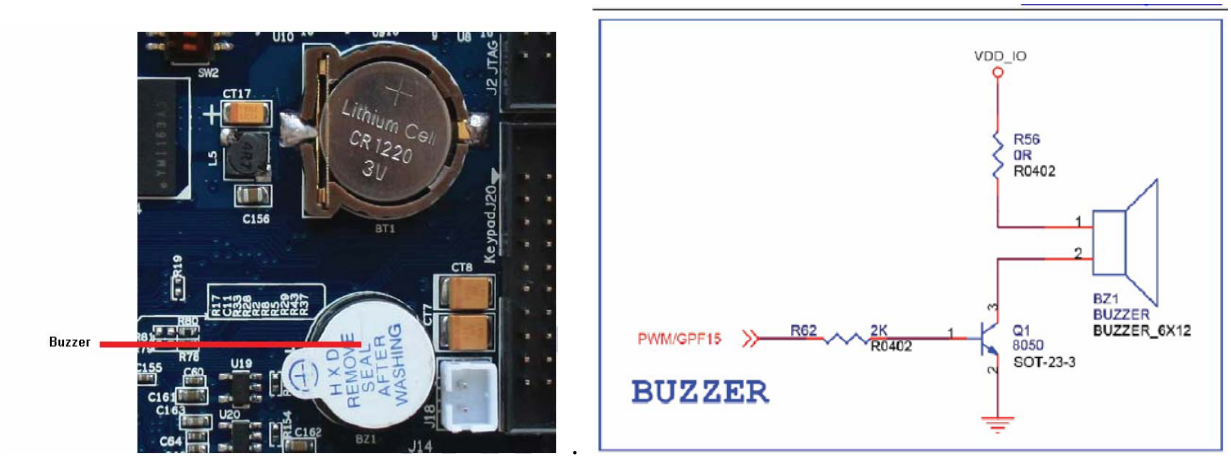
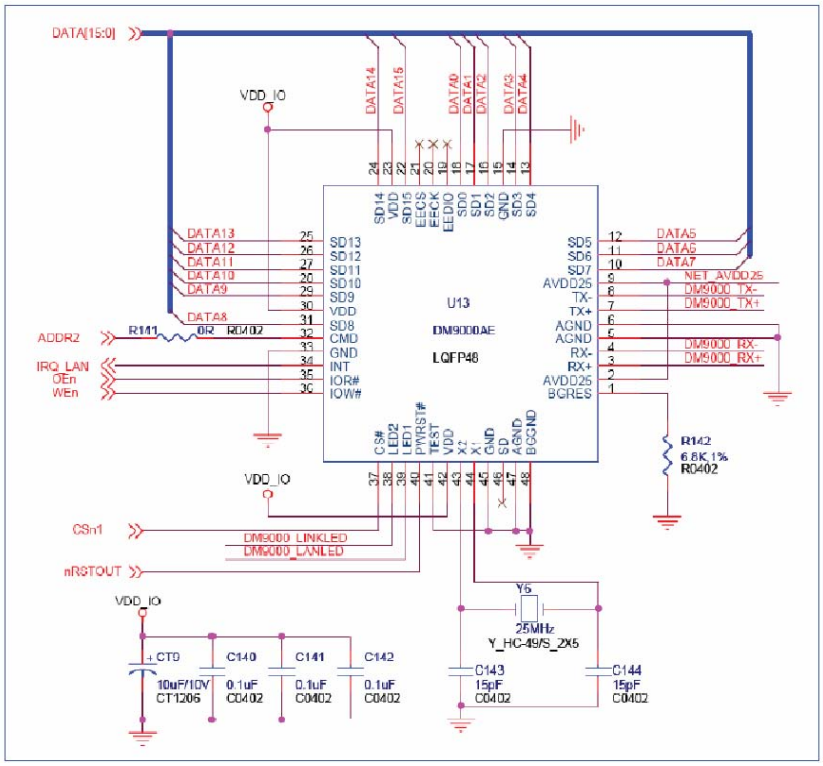


Figure4.8 the picture and circuit drawing of Buzzer

4.10. 100M Ethernet interface

The Ethernet interface is supplemented on the board by the Ethernet Transformer and the RJ45 connector. The Ethernet controller is external chip DM900AE, the chip call on the external CPU interrupt signal EINT7

On the process of the development, the interface can connect with PC via cross Ethernet line to download WinCE Image, Linux Kernel and File System. Below circuit drawing is about Ethernet interface.



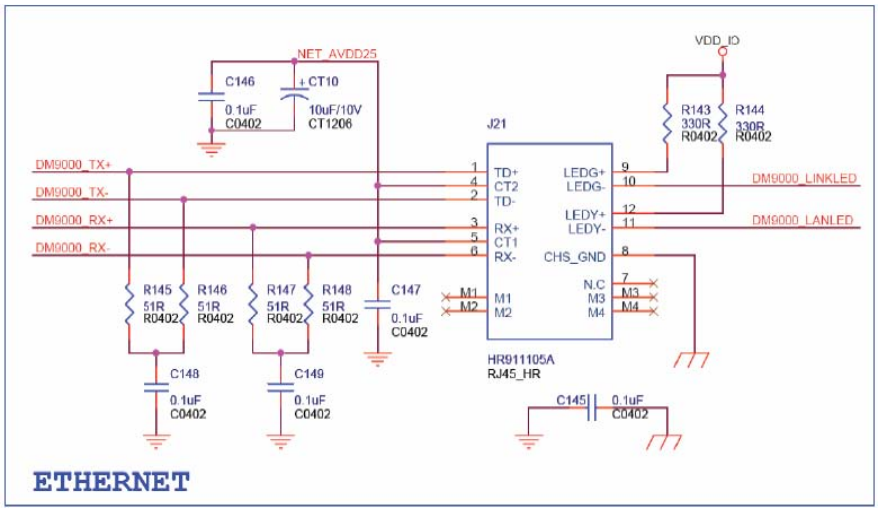
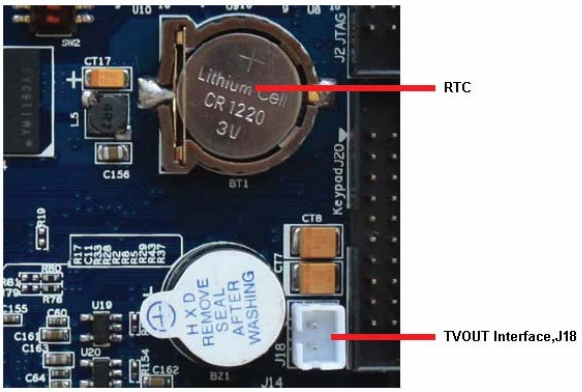


Figure4.9 the circuit drawing of Ethernet connector

4.11. TVOUT interface

S3C6410 Board has a 2-pin 2.0 pitch TVOUT interface at connector J18. Below pictures are about TVOUT interface.



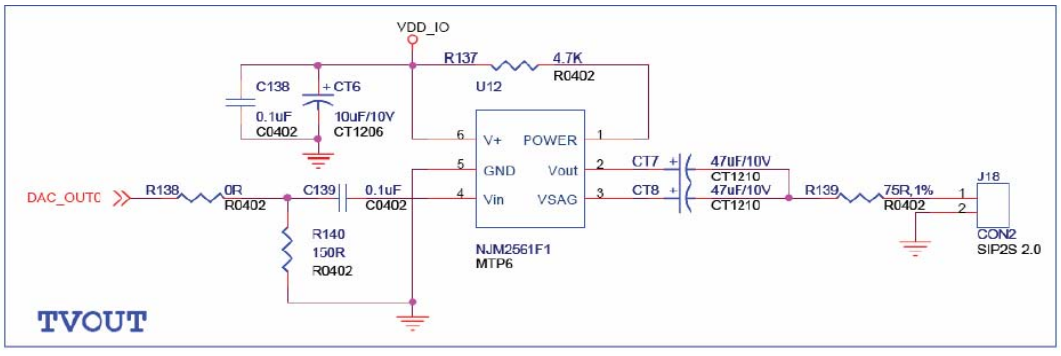


Figure4.10 the circuit drawing of TVOUT connector

4.12. High Speed SPI, MMC2 and I2C interface

The S3C6410 Board has two SPI interfaces and one I2C interface. They adopts 2.0mm pitch space biserial dip connector J21 and J23, in which J22 contains SPI1 and MMC2, J23 contains SPI0,IIC and GPIO. The SPI1 is reused with MMC2 on the pin of the main chip, the customer use SPI interface to conveniently debugging WIFI and Digital TV modules.

Below pictures are about SPI, MMC2 and I2C.

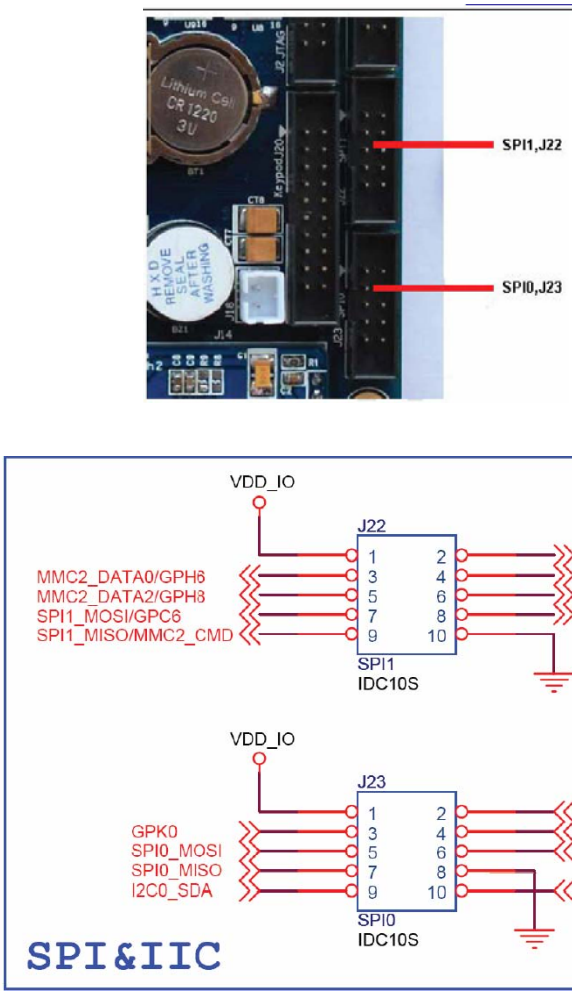
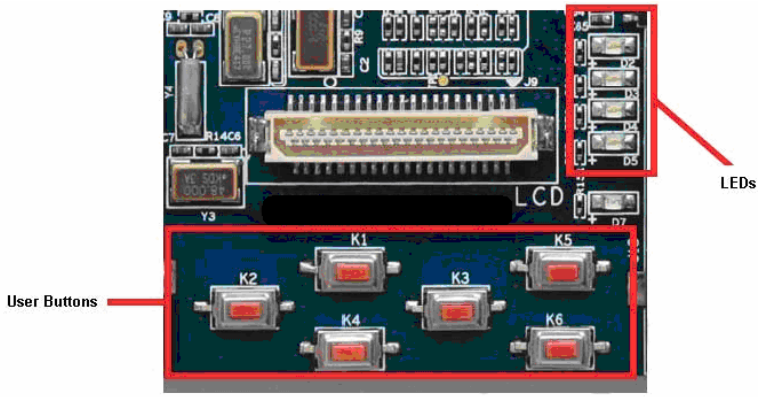


Figure4.11 the circuit drawing of SPI & ICC

4.13. User Buttons and LEDs

There are 6 pieces of user button, and 4 pieces of LED. User buttons and LEDs are controlled by GPIO, it accepts interrupt mode and query mode.The user can program them according to requirement. LED on indicates high level, LED off indicates low level. Below circuit drawing is about them.



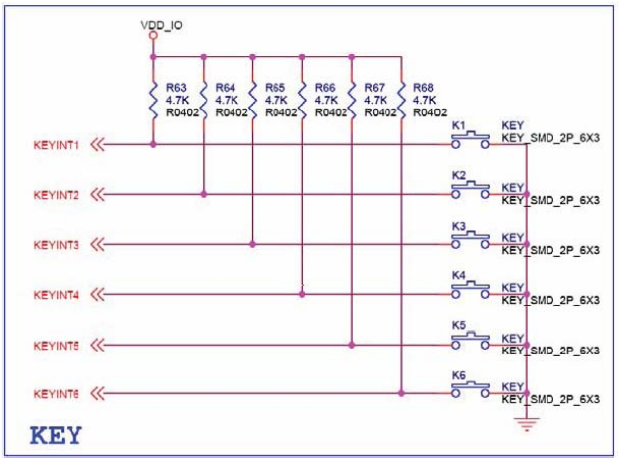


Figure4.12 the circuit drawing of user buttons & LEDs

4.14. GPIO and ADC

S3C6410 board has totally 186 GPIO. The GPIO can be set as multiplex use, output port, input port , external interrupt and special function. But this group GPIO K, L, M, N can not be controlled status under sleep mode, about detail please refer to the chapter GPIO in the data sheet of S3C6410.

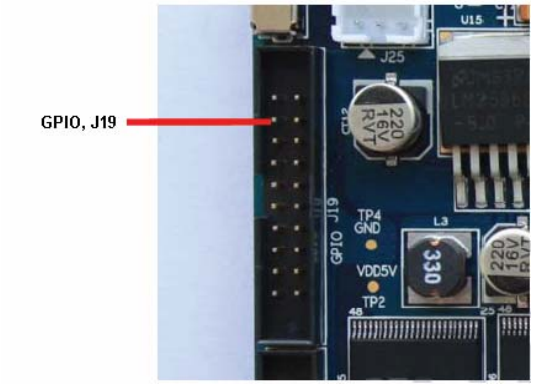
The S3C6410 Board provides 24 GPIO to the user, in which 11 GPIO are at biserial 10*2 pin header connector J25, which also contains 4 ADC and 1 DAC, the customer can use them according to the requirement. The main chip S3C6410 totally has 8 ADC, in which 4 ADC ADC4-ADC7 are used to control Touch Screen.

The last GPIO are used in below places:

- 7 GPIO is used at UART interface J2,
- 3 GPIO is used at LCD&TSP connector J9,
- 1 GPIO is used at CAMERA connector J10,
- 2 GPIO is use at SPIO connector J23

Above 18 GPIO is mainly used for LCD, SPI/I2C, BUS connectors, the user also can use those GPIO for other uses.

Below pictures are about GPIO, ADC



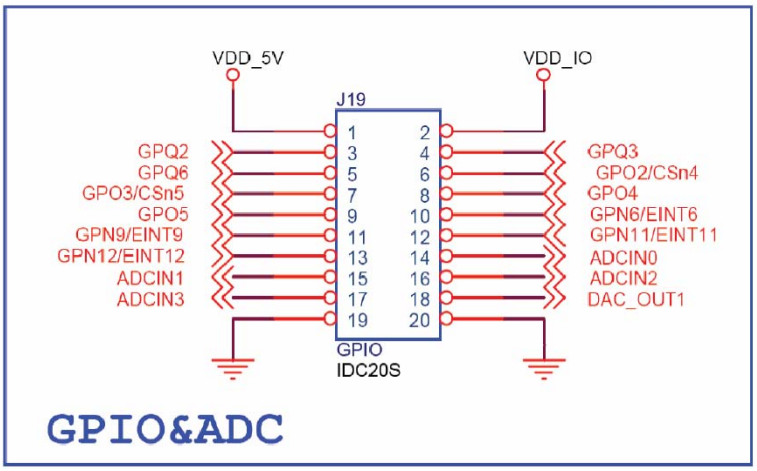


Figure4.13 the pictures and circuit drawing of GPIO and ADC

4.15. RTC

The board is equipped with a battery with type of 1220, when no power supply RTC provides power VDD_RTC for S3C6410. Below circuit drawing is about RTC.

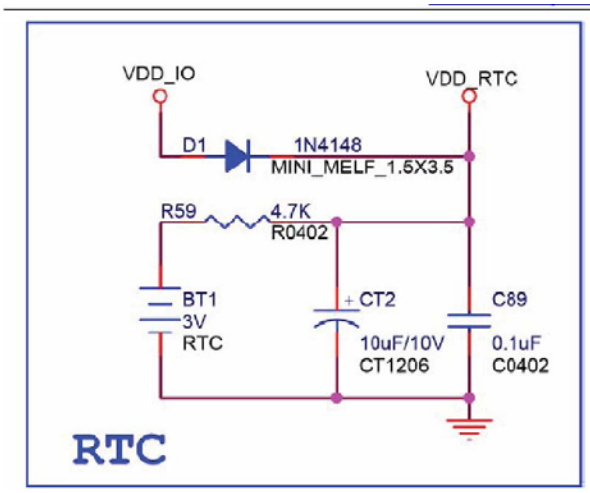


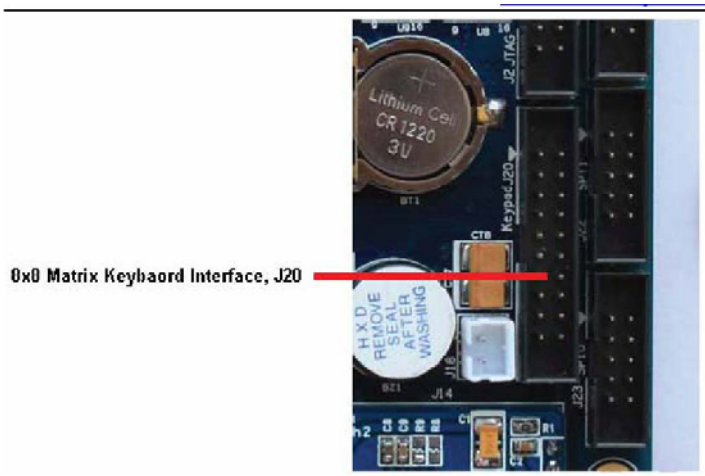
Figure4.14 the circuit drawing of RTC

4.16. 8x8 Matrix Keyboard

The CPU is built up support matrix keyboard, the maximal limited keys is 8x8. S3C6410 Board adopts a biserial 10x2 2.0mm pitch pin header connector J20 for matrix keyboard.

Embest developed a 4x4 matrix keyboard which can directly connect with the connector J20. The 4x4 matrix keyboard also is equipped with a USB_HUB interfaces so that the user can use it to expand the USB HOST into 4 pieces.

Below pictures are about Matrix Keyboard:



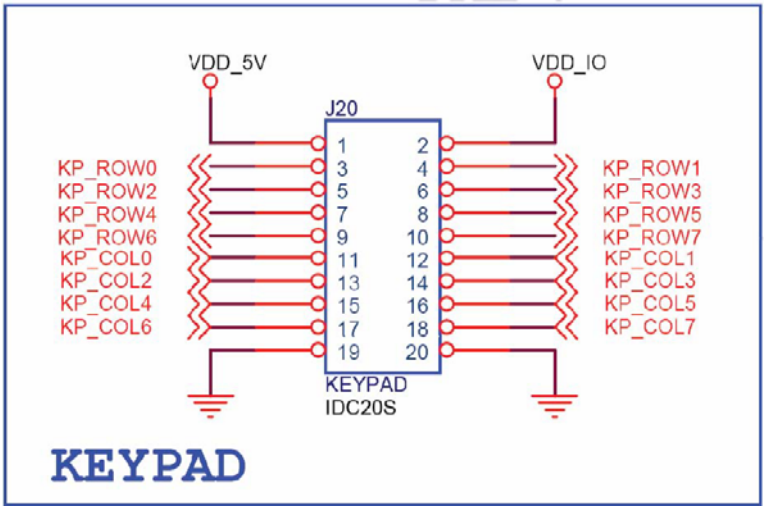


Figure4.15 the picture and circuit of the Matrix Keyboard