

## INFORMATION:

EEES has succeeded in researching and developing the KM9260 Linux embedded board. KM9260 is the embedded board based on the ARM9 Cor microcontroller. KM9260 has a compact dimension, the strong functions and is used the AT91SAM9 microcontroller of ATMEL corporation. KM9260 board can either work on the Linux, WinCE and  $\mu$ C/OS-II RTOS operation systems or run applied programs (standalone) as other the microcontrollers.

## FEATURERS:

- MCU AT91SAM9260, 16/32 bit ARM926EJ-S 180Mhz.
- Standard JTAG Connector with ARM 2x10 pin layout for programming/debugging with ARM-JTAG
- 32MB SDRAM.
- 256MB NAND FLASH.
- 512kB SPI serial dataflash.
- Ethernet 10/100 base RJ45 connector.
- USB host, device connector.
- RS232 connector.
- Micro SD card slot.
- Buttons, LEDs.
- Extension Connector.
- Single power supply: 5V DC required.

## SOFTWARE:

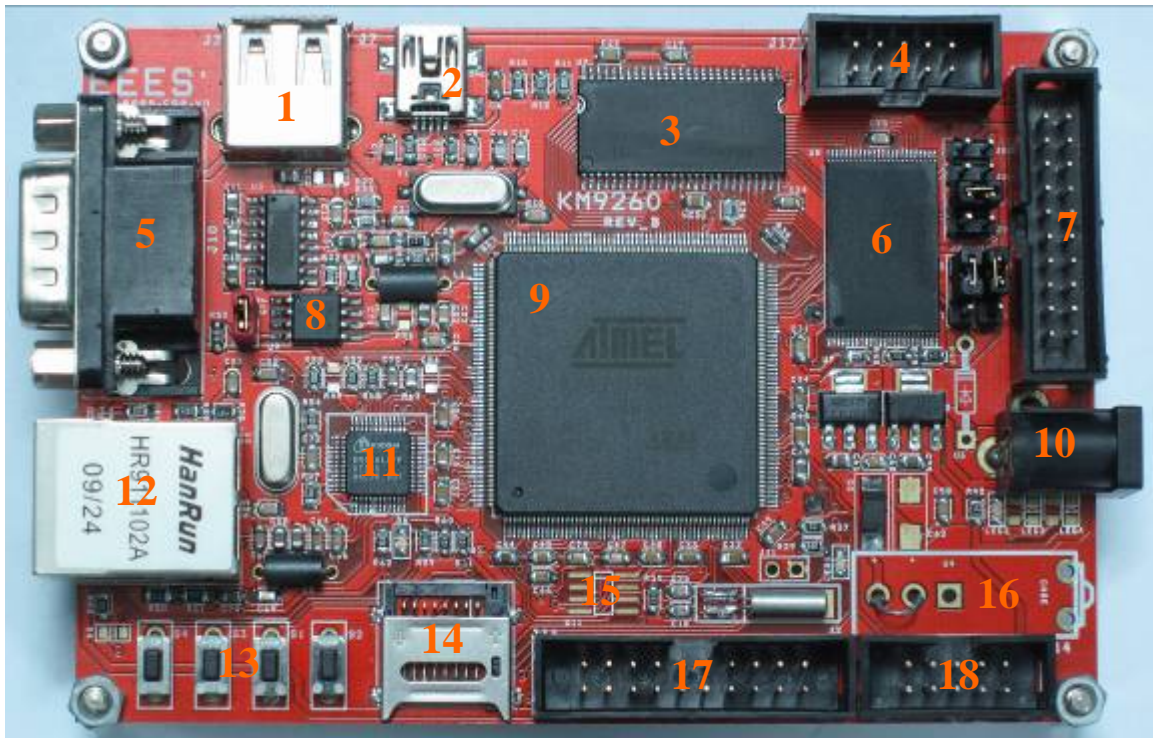
- AT91BootStrap-1.1.3 (binary).
- u-boot-1.3.4 (binary).
- kernel-2.6.27 and patch file.
- Angstrom, Debian rootfs.

## ACCESSOIRES:

- Power supply 5V DC.
- USB miniB Cable.
- Cable RS232 BD9 connector.
- 512MB MicroSD card (optional).
- ZyDas USB-Wifi adapter (optional).
- DVD.

**Linux****WinCE** **$\mu$ C/OS-II****KM9260**

**BOARD IMAGE:**



**Specifications:**

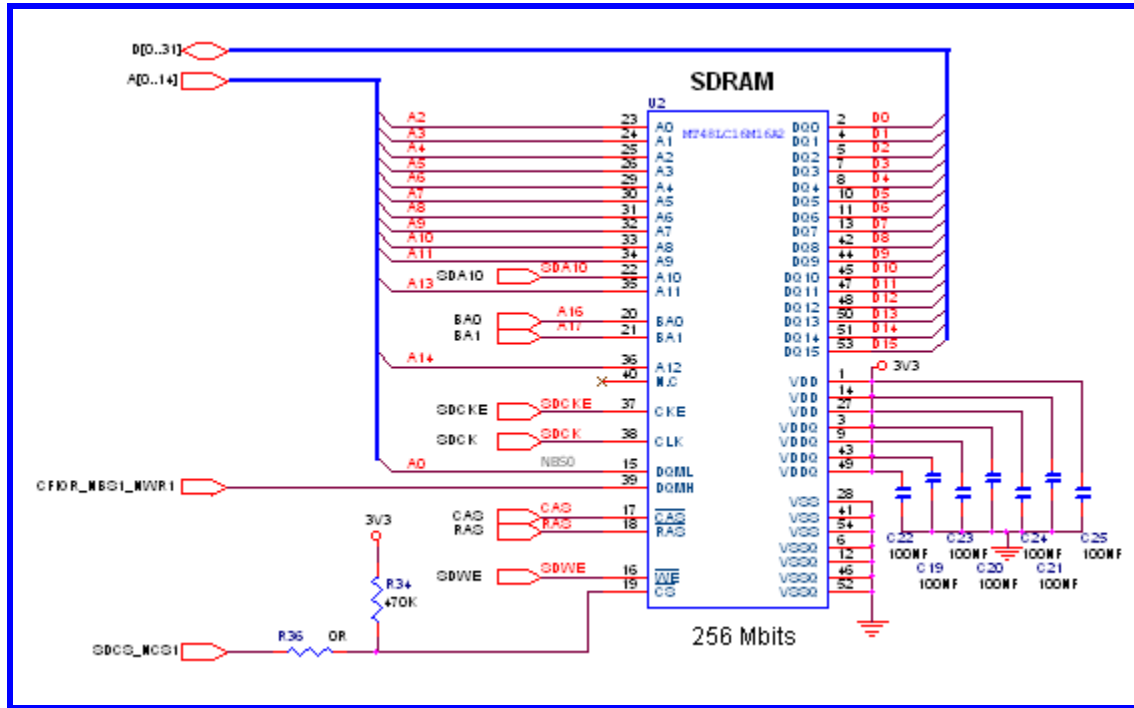
No.	Name	Function
1	J3	USB Host Connector (Type A)
2	J7	USB Device Connector (Type Mini B)
3	U2	MT48LC16M16A2, SDRAM 256Mb (32MB) 133Mhz
4	J17	SCI Interface (I2S) Extension Connector
5	J10	BD9 Male Connector (DBU, RS232)
6	U8	K9F2G08UOM, NAND Flash (256MB)
7	J5	JTAG ICE Interface
8	U9	Serial dataflash (512kB)
9	U1	AT91SAM9260, 16/32 bit ARM926EJ-S 180Mhz
10	J12	5VDC Power Connector
11	U5	DM9161EA, Ethernet 10/100 Full-Duplex
12	RJ1	Integrated Transformer Ethernet Connector (RJ45)
13	S1, S2, S3, S4	Wake Up, Reset, User Button 1, User Button 2
14	U10	MicroSD Card Socket
15	U11	I2C EEPROM
16	J12	Power Switch
17	J16	Uart, TWI, ADC Extension Connector
18	J14	SPI Extension Connector

## CPU's FEATURERS:

- **180 MHz ARM926EJ-S™ ARM® Thumb® Processor.**
  - 8 KBytes Data Cache, 8 KBytes Instruction Cache, MMU.
  
- **Memories**
  - 32-bit External Bus Interface supporting 4-bank SDRAM/LPSDR, Static Memories, CompactFlash, SLC NAND Flash with ECC.
  - Two 4-kbyte internal SRAM, single-cycle access at system speed.
  - One 32-kbyte internal ROM, embedding bootstrap routine.
  
- **Peripherals**
  - ITU-R BT. 601/656 Image Sensor Interface.
  - USB Device and USB Host with dedicated On-Chip Transceiver.
  - 10/100 Mbps Ethernet MAC Controller.
  - One High Speed Memory Card Host.
  - Two Master/Slave Serial Peripheral Interfaces.
  - Two Three-channel 32-bit Timer/Counters.
  - One Synchronous Serial Controller.
  - One Two-wire Interface.
  - Four USARTs.
  - Two UARTs.
  - 4-channel 10-bit ADC.
  
- **System**
  - 90 MHz six 32-bit layer AHB Bus Matrix.
  - 22 Peripheral DMA Channels.
  - Boot from NAND Flash, SDCard, DataFlash® or serial DataFlash.
  - Reset Controller with On-Chip Power-on Reset.
  - Selectable 32,768 Hz Low-Power and 3-20 MHz Main Oscillator.
  - Internal Low-Power 32 kHz RC Oscillator.
  - One PLL for the system and one PLL optimized for USB.
  - Two Programmable External Clock Signals.
  - Advanced Interrupt Controller and Debug Unit.
  - Periodic Interval Timer, Watchdog Timer and Real Time Timer.
  
- **I/O**
  - Three 32-bit Parallel Input/Output Controllers.
  - 96 Programmable I/O Lines Multiplexed with up to Two Peripheral I/Os.
  
- **Package**
  - 217-ball BGA, 0.8 mm pitch.
  - 208-pin QFP, 0.5 mm pitch.

**MEMORY MAP:**

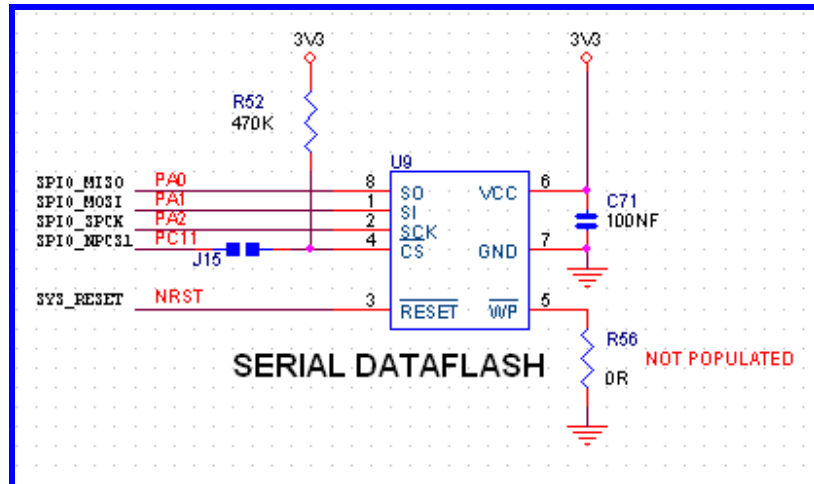
**• SDRAM**



Main memory is SDRAM bus 133Mhz, SDRAMC with 16 bit data bus. Table shows the parameters of memory map of SDRAM in the system.

<b>Part number</b>	MT48LC16M16A2 TC75
<b>Chip select</b>	NCS1
<b>Base address</b>	0x20000000
<b>Size</b>	0x2000000 (32MB)

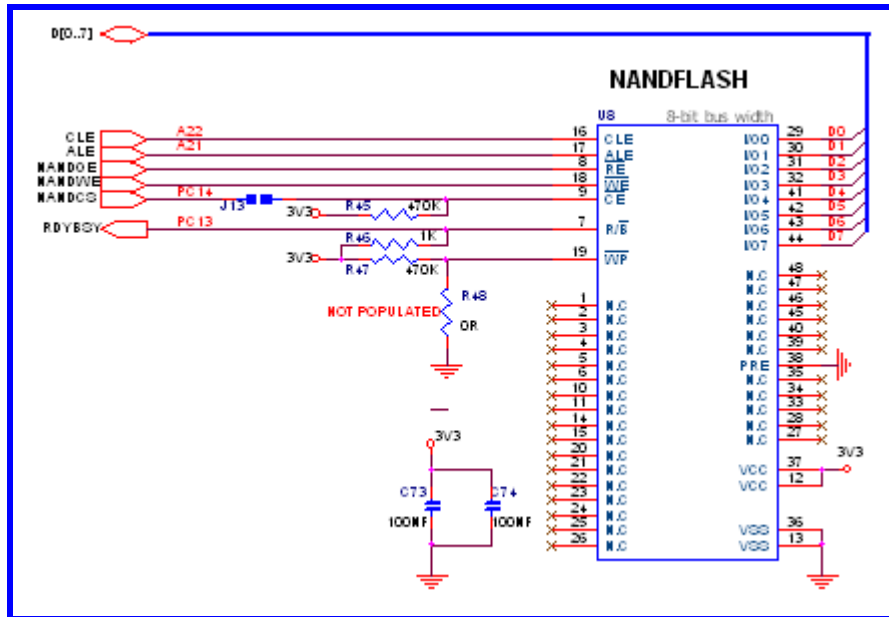
**• Serial Dataflash**



Board uses memory chip with serial dataflash connected by SPI0 (slot CS1). AT91Bootstrap, U-Boot's Environment Variables, U-Boot are stored in serial dataflash. The segments of bootloaders are shown by the following table:

<b>Part number</b>	AT45DB041D-SU	
<b>Chip select</b>	NCS2	
<b>Logical address</b>	0xD0000000	
<b>Offset</b>	<b>Area</b>	<b>Description</b>
0x00000000	0	Bootstrap
0x00004200	1	Environment
0x00008400	2	U-Boot
<b>Size</b>	0x80000 (512kB)	

• NAND Flash

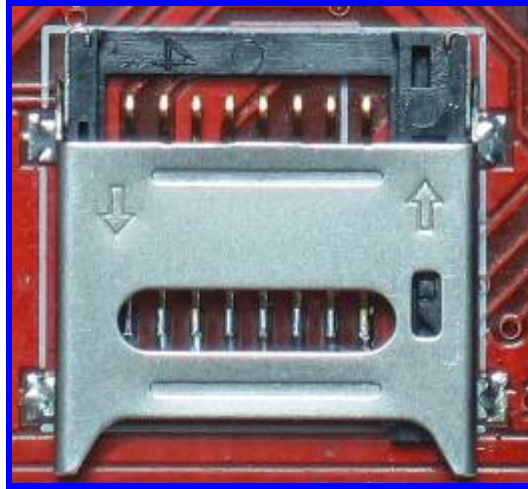


NAND Flash (256MB) is used to stored the Linux core and root file system. The first 3MB of the memory area is used to stored kernel Linux, the others used to store the root files system.

Table shows the memory map's parameters of NAND Flash.

<b>Part number</b>	K9F2G08UOM	
<b>Chip select</b>	NCS3	
<b>Base address</b>	0x40000000	
<b>Offset</b>	<b>Partition</b>	<b>Description</b>
0x00000000	0	Kernel
0x00300000	1	Rootfs (JFFS2)
<b>Size</b>	0x10000000 (256MB)	

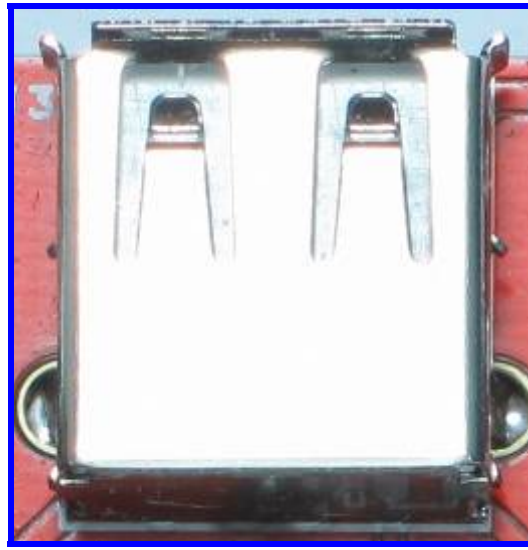
- **MicroSD Connector:**



MicroSD can replace NAND Flash on storing kernel Linux and roots files. The first partition is formatted as FAT. The second partition is formatted as ext2 or ext3 to store roots. To load kernel Linux from MicroSD to SDRAM require that U-Boot have to support mmc sub system command set. MicroSD is used to boot Linux which has large roots size, e.g. as Debian distribution.

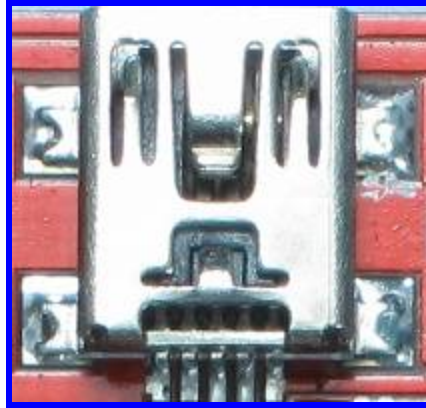
### CONNECTOR:

- **USB Host Connector:**



USB host full speed is family with MicroSD, the system can boot Linux by USB drive. Additional, we can upgrade the functions of sound for the KM9260 board by adding HID sound adapter.

- **USB Device Connector:**



With USB device connector, we can change embedded board into USB devices such as HID (keyboard & mouse), CDC (serial communication), RDN or mass storage... All these devices are belong to USB gadget in driver source of Linux. Moreover, the MCU of AT91SAM9260 enables us to access all memory partitions by applications on the computer SAMBA.

- **Serial DBGU (BD9 MALE):**



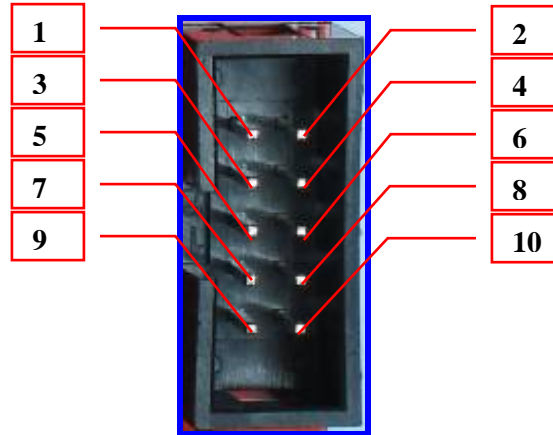
AT91SAM9260 has RS232 connector to debug system. KM9260 uses DBGU to show inputs, outputs by the console of Linux.

- **Ethernet Connector:**



AT91SAM9260 is integrated MAC (base 10/100 full-duplex) controller, combined with Fast Ethernet PHY DM9161AEP chip that will make the system stronger with applications of network. KM9260 can be used as embedded webserver system applied in data collection system and remote controller....

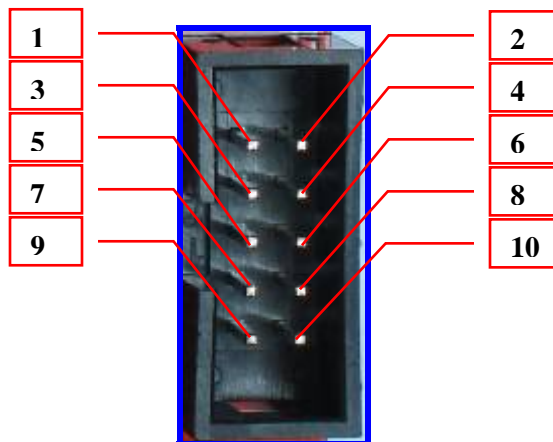
• **SSC Extension Connector (J17) :**



Pin No.	Signal Name	MCU Pin No.	Pin No.	Signal Name	MCU Pin No.
1	GND	-	2	5V	-
3	GND	-	4	3V3	-
5	TK0	23 (PB16)	6	TF0	26 (PB17)
7	TD0	27 (PB18)	8	RD0	28 (PB19)
9	RK0	163 (PB20)	10	RF0	164 (PB21)

Connector enable us to extend connections to I2S audio codec devices. It can be transmitted and received 32bit stream data (High-speed Continuous Data Stream)...

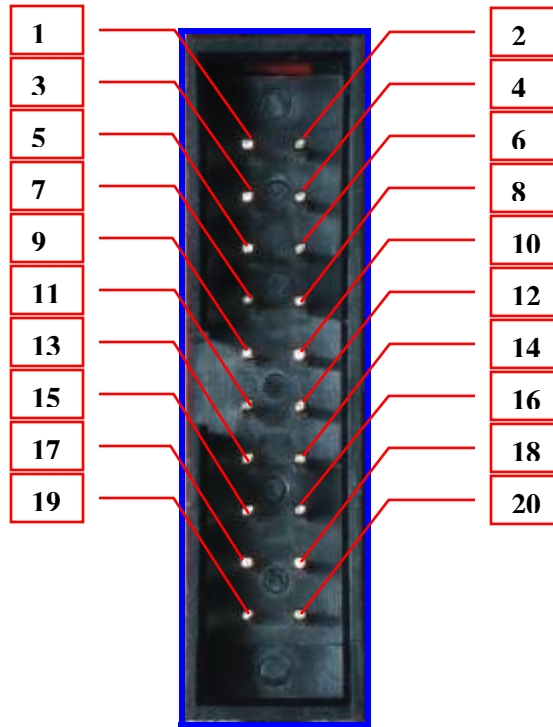
• **SPI Extension Connector (J14) :**



Pin No.	Signal Name	MCU Pin No.	Pin No.	Signal Name	MCU Pin No.
1	GND	-	2	3V3	-
3	SPI1_MISO	9 (PB0)	4	SPI1_MOSI	10 (PB1)
5	SPI1_SPCK	11 (PB2)	6	SPI1_NPCS0	12 (PB3)
7	SPI1_NPCS1	67 (PC5)	8	SPI1_NPCS2	62 (PC4)
9	GPIO	63 (PC6)	10	GPIO	64 (PC7)

SPI1 extended connector includes 3 pins for chip selection as 3 slots CS0, CS1 and CS2. One interfaced devices (SPI standard) are required a reset signal and IRQ by Pin #9 and Pin #10.

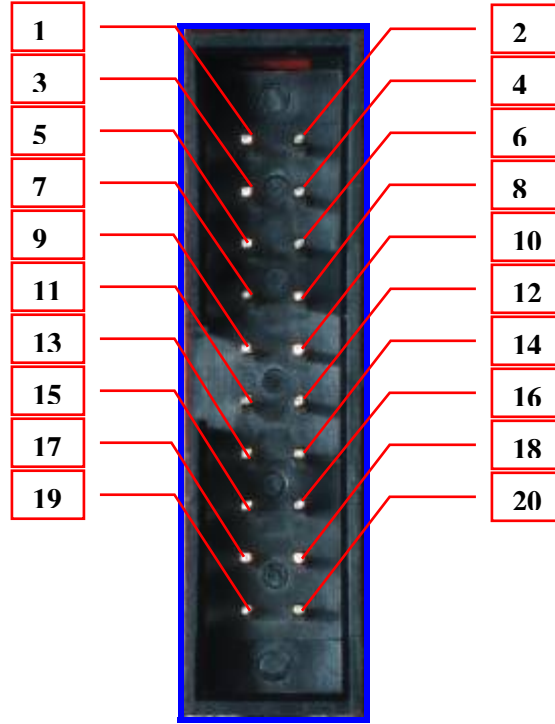
• **UART, ADC, TWI Extension Connector (J16) :**



Pin No.	Signal Name	MCU Pin No.	Pin No.	Signal Name	MCU Pin No.
1	5V	-	2	3V3	-
3	AVDD	-	4	GND	-
5	AGND	-	6	VREFP	-
7	AD0	158 (PC0)	8	AD1	159 (PC1)
9	IRQ1	127 (PC15)	10	UART_TXD0	15 (PB4)
11	UART_RXD0	16 (PB5)	12	UART_TXD1	17 (PB6)
13	UART_RXD1	18 (PB7)	14	UART_TXD2	19 (PB8)
15	UART_RXD2	20 (PB9)	16	UART_TXD3	161 (PB10)
17	UART_RXD3	162 (PB11)	18	TWD	208 (PA23)
19	TWCK	1 (PA24)	20	GPIO	23 (PB16)

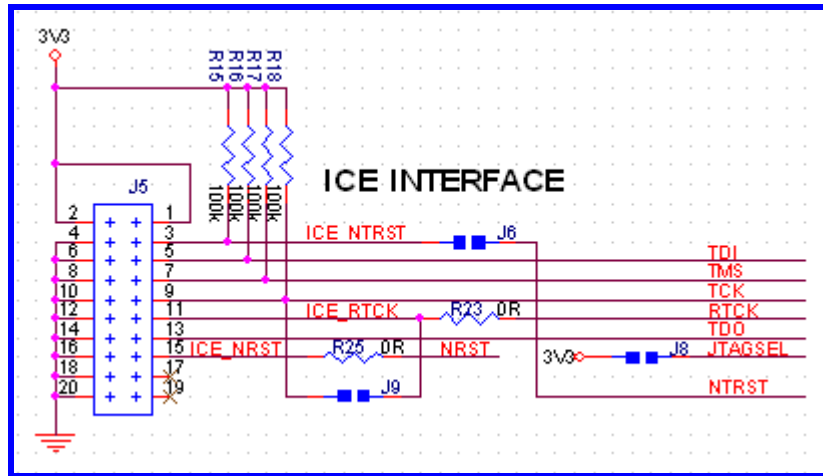
Extended Connector for serial interface includes UART, TWI, ADC inverter, GPIO and IRQ1.

• **JTAG ICE Interface (J5) :**



Pin No.	Signal Name	MCU Pin No.	Pin No.	Signal Name	MCU Pin No.
1	3V3	-	2	3V3	-
3	NTRST	35	4	GND	-
5	TDI	30	6	GND	-
7	TMS	31	8	GND	-
9	TCK	34	10	GND	-
11	RTCK	37	12	GND	-
13	TDO	29	14	GND	-
15	NRST	36	16	GND	-
17	NC	-	18	GND	-
19	NC	-	20	GND	-

JTAG ICE connector, 20-pin standard enable us to input programs and debug system. Below picture shows the schematic of JTAG connector.



**BUTTONS:**

- **Reset (S2) :**



Reset system, negative activation

- **Wake up (S1) :**



Waking the system up in the power down status.

- **User Button 1 (S3) :**



User button is connected to PC15 (pin#127 of AT91SAM9260 MCU).

Action	Logic Output
Press	0
Unpress	1

• **User Button 2 (S4) :**



User button is connected to PC8 (pin#61 of AT91SAM9260 MCU).

Action	Logic Output
Press	0
Unpress	1

LEDs:

• **Status LEDs:**

Name	Function	Status	Description
LED1	Shutdown	on	Power down
		off	Normal operation
LED2	Power	on	Turn power on
		off	Turn power off
D6	Duplex	on	Ethernet PHY full-duplex
		off	Ethernet PHY half-duplex

• **User LED :**

Name	MCU Pin
D4	PA6 (Pin 185)

Negative activation:

- PA6 low : D4 on
- PA6 high: D4 off

**JUMPER:**

• **Chip Select Enable Jumpers :**

Name	Function	Default Position
J15	Serial dataflash CS enable	Closed
J13	NAND Flash CS enable	Closed

Chip select enable jumpers are designed to restore boot loader files after user write the improper programs into Bootstrap or U-Boot. The ways of restoring boot loader are available in the ” [KM9260\\_Technical\\_Reference\\_English\\_V1.0.pdf](#)”.

The picture of (J15) jumper#15:



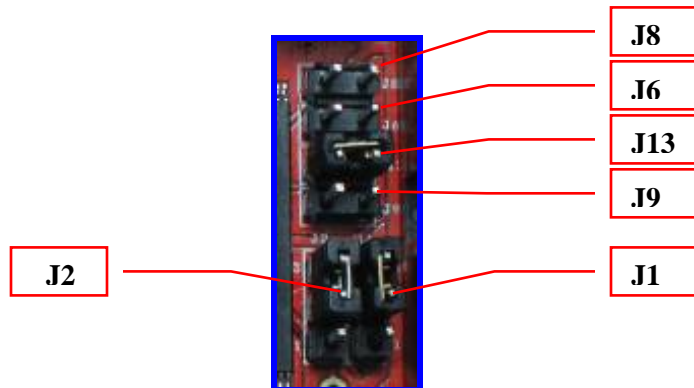
• **System Configuration Jumpers :**

Name	Function	Position	Description	Default
J1	OSCSEL level select	1-2	Use internal RC	2-3
		2-3	Use 32,768kHz	
J2	VDDDBU power source select	1-2	Lithium battery	1-2
		2-3	1V8 (main power)	

• **JTAG Associated Jumpers :**

See the schematic of **JTAG ICE Interface** at above items

Locations of Jumper:



## SOFTWARE:

The software is included bootloader (U-Boot) and Linux operation system.

### Items Included on CD:

- 1> AT91Bootstrap (Binary).
- 2> U-Boot-1.3.4 (Binary).
- 3> linux-2.6.27.tar.bz2 + patch file.
- 4> Roots:
  - + Angstrom-console-image-demo-glibc.rootfs.jffs2 (used with NAND Flash).
  - + Angstrom-km9260-01012010.tar (used with MicroSD Flash).
  - + Debian Leny: Debian\_km9260\_rootfs.tar.bz2 (used with MicroSD, USB flash disk).

### Tools:

- 1> Install AT91-ISP v1.13.exe (File installs SAMBA for WinXP).
- 2> arm-2007q3.tar.bz2. (Cross compiler, used with Angstrom).
- 3> Generic-arm\_gcc-4.2.3-glibc-2.3.3.tar (Cross compiler, used with Debian).
- 4> tftpd32.rar (WinXP)
- 5> putty.exe (WinXP)
- 6> winscp418.exe (WinXP).

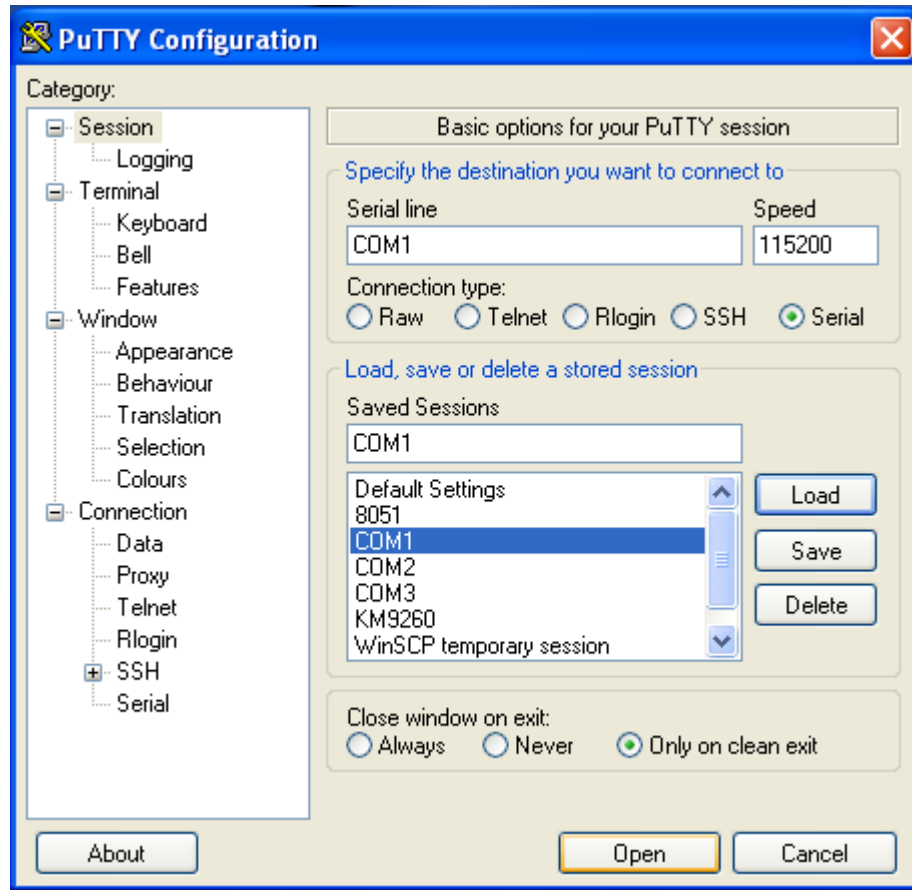
## BEGINNING WITH KM9260 LINUX EMBEDDED BOARD:

Boards have available AT91Bootstrap, U-Boot-1.3.4 in SPI serial dataflash. Kernel-2.6.27 and Angstrom JFFS2 roots installed on NAND flash.

After turning board on, it will boot Angstrom Linux system from NAND Flash

### Preparations:

- 1> LAN cable (RJ45).
- 2> RS232 cable from board to computer.
- 3> Run putty.exe file
- 4> Checking on radio “Serial” option.
- 5> Selecting COM port in “Serial line” menu.
- 6> Selecting baud rate is 115200 in “Speed” box.
- 7> Press “Open” button.
- 8> Turn the “power” button on and press “reset” button to restart the system.



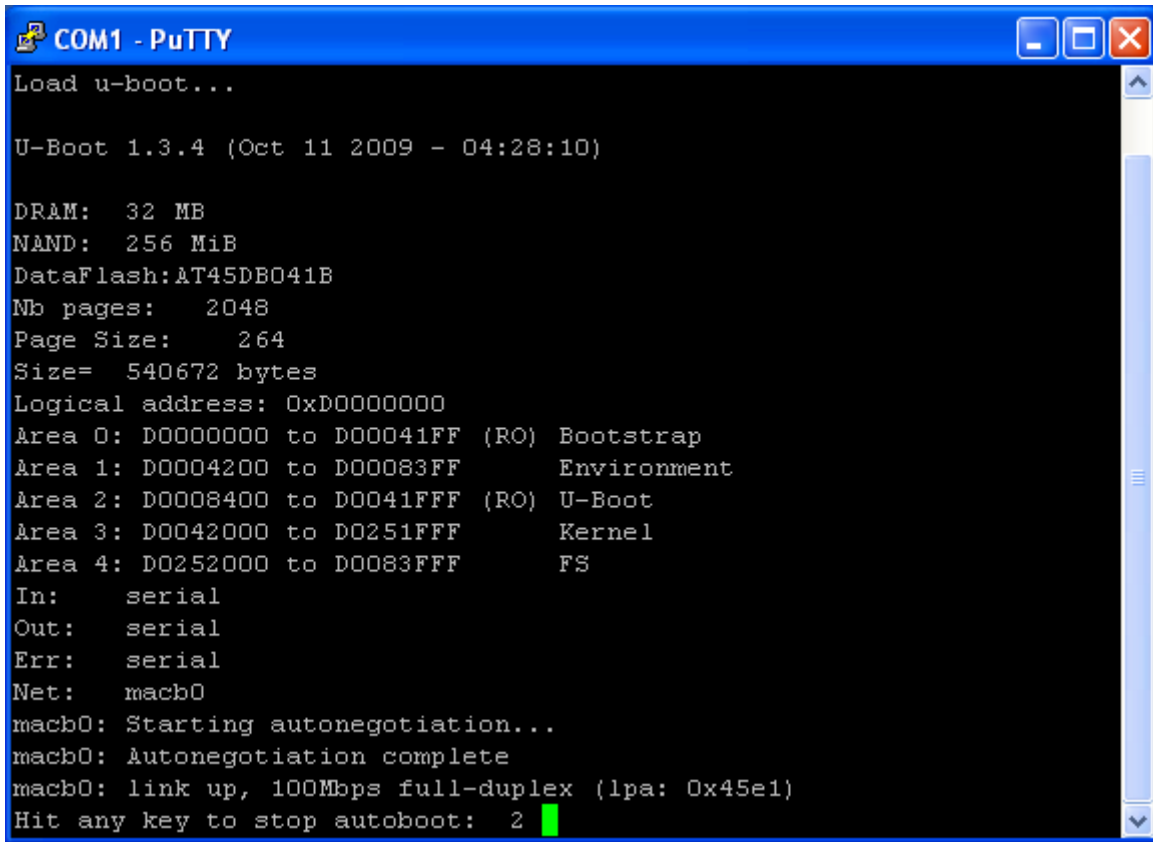
Hình: Putty.exe

### **AUTOBOOT WITH ANGSTROM JFFS2 ROOTS:**

Pressing the “Open” button, the putty console will be shown on the screen with the prompt of U-Boot. After 3 second, if we don’t press the input buttons for console, the system will boot default as autoboot (available on the “bootcmd” variation). KM9260 boards have set up autoboot with Angstrom JFFS2 roots.

Kernel (uImage) is stored in the partition#0. Roots are stored in the partition#1 of NAND Flash (See the memory map of NAND Flash above). The “bootcmd” variation is set by the following values:

```
U-Boot> setenv bootcmd 'nand read 0x20000000 0x0 0x200000; bootm 0x20000000'
U-Boot> setenv bootargs root=/dev/mtdblock1 rw rootfstype=jffs2
U-Boot> save
```



```

COM1 - PuTTY
Load u-boot...

U-Boot 1.3.4 (Oct 11 2009 - 04:28:10)

DRAM: 32 MB
NAND: 256 MiB
DataFlash: AT45DB041B
Nb pages: 2048
Page Size: 264
Size= 540672 bytes
Logical address: 0xD0000000
Area 0: D0000000 to D00041FF (RO) Bootstrap
Area 1: D0004200 to D00083FF Environment
Area 2: D0008400 to D0041FFF (RO) U-Boot
Area 3: D0042000 to D0251FFF Kernel
Area 4: D0252000 to D0083FFF FS
In: serial
Out: serial
Err: serial
Net: macb0
macb0: Starting autonegotiation...
macb0: Autonegotiation complete
macb0: link up, 100Mbps full-duplex (lpa: 0x45e1)
Hit any key to stop autoboot: 2 █
  
```

Figure : U-Boot console

**First step for setting the U-Boot:**

```

U-Boot> setenv ipaddr 192.168.1.35
U-Boot> setenv serverip 192.168.1.34
U-Boot> setenv ethaddr 00:11:22:33:44:55
U-Boot> setenv netmask 255.255.255.0
U-Boot> save
  
```

**To load Kernel uImage into Partition#0 of NAND Flash do followings:**

- 1> Run “tftpd32.exe” on winXP, with share folder has uImage.
- 2> Firstly, we delete partition #0 and download uImage from computer into SDRAM (by LAN connected to tftpd server)

```

U-Boot> nand erase 0 0x200000
U-Boot> tftp 0x20000000 uImage
  
```

- 3> Copy uImage from SDRAM to NAND Flash.

```

U-Boot> nand write 0x20000000 0x0 0x200000
  
```

uImage can be loaded from NAND into SDRAM by following command:

```
U-Boot> nand read 0x20000000 0x0 0x200000
```

**To load JFFS2 roots into partition#1 of NAND Flash do the followings:**

- 1> Run “tftpd32.exe” on winXP, with share folder has JFFS2 roots
- 2> Firstly, we delete partition#1 and download JFFS2 roots from computer into SDRAM (by LAN connected to tftpd server).

```
U-Boot> nand erase 0x400000 0x18E0000
U-Boot> tftp 0x20000000 Angstrom-console-image-demo-glibc.rootfs.jffs2
```

- 3> Copy JFFS2 roots from SDRAM into NAND Flash.

```
U-Boot> nand write.jffs2 0x20000000 0x400000 0x18E0000
```

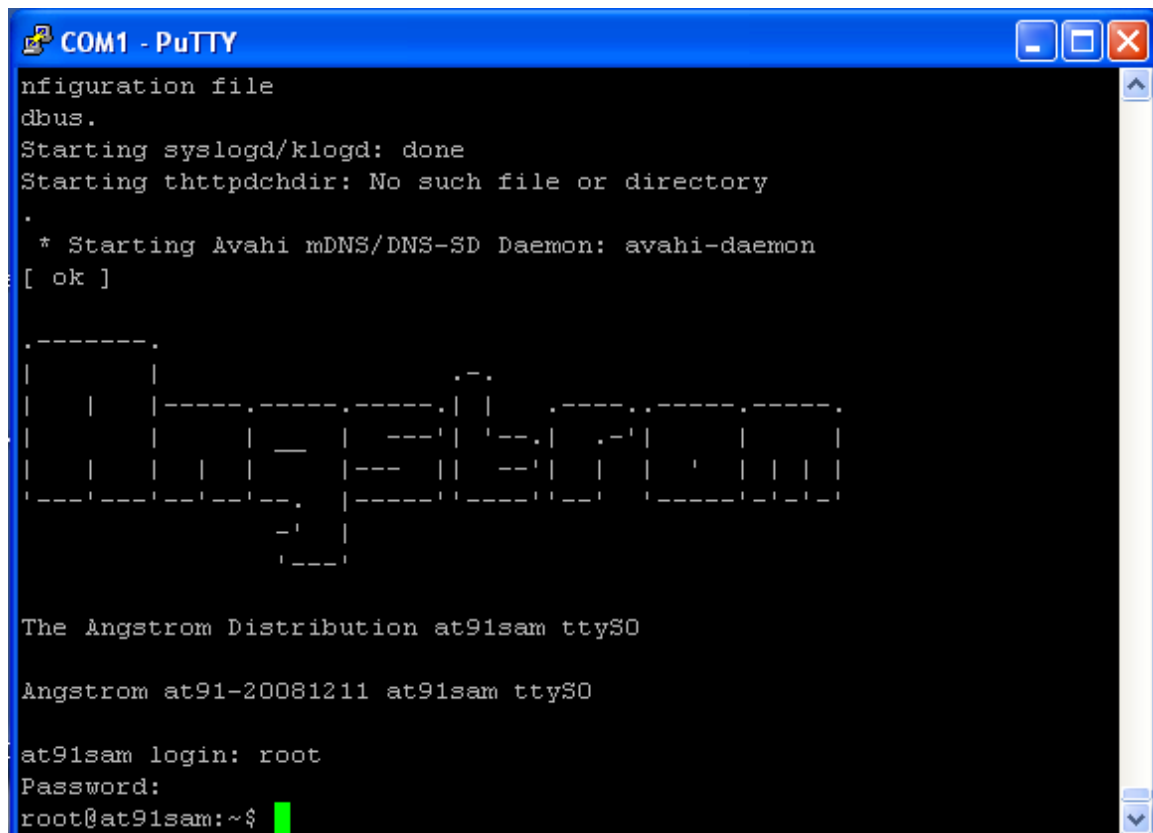


Figure: Boot Angstrom uses JFFS2 roots on NAND Flash.

**Note:** Login; account : username = root, password = km9260

**USING DEBIAN LENO ROOTS:**

Debian roots is the good environment to develop Linux for KM9260. There are many softwares. It is easy to install by using “apt-get” tool. However, Debian roots have the large size (over 1GB). So, Debian just is suitable with the hard drives as SD card, USB Flash Disk. With KM9260, Debian can be booted from microSD card, when the bootargs parameter of U-Boot changed as following:

```
U-Boot> setenv bootargs console=ttyS0,115200 root=/dev/mmcblk0p1 rootdelay=5
U-Boot> save
```

**Note:**

The “root=/dev/mtdblock1” parameter can be changed by the number of partition on card microSD.

After defining the parameters, we can boot Debian with  
 Username: root  
 Password: km9260

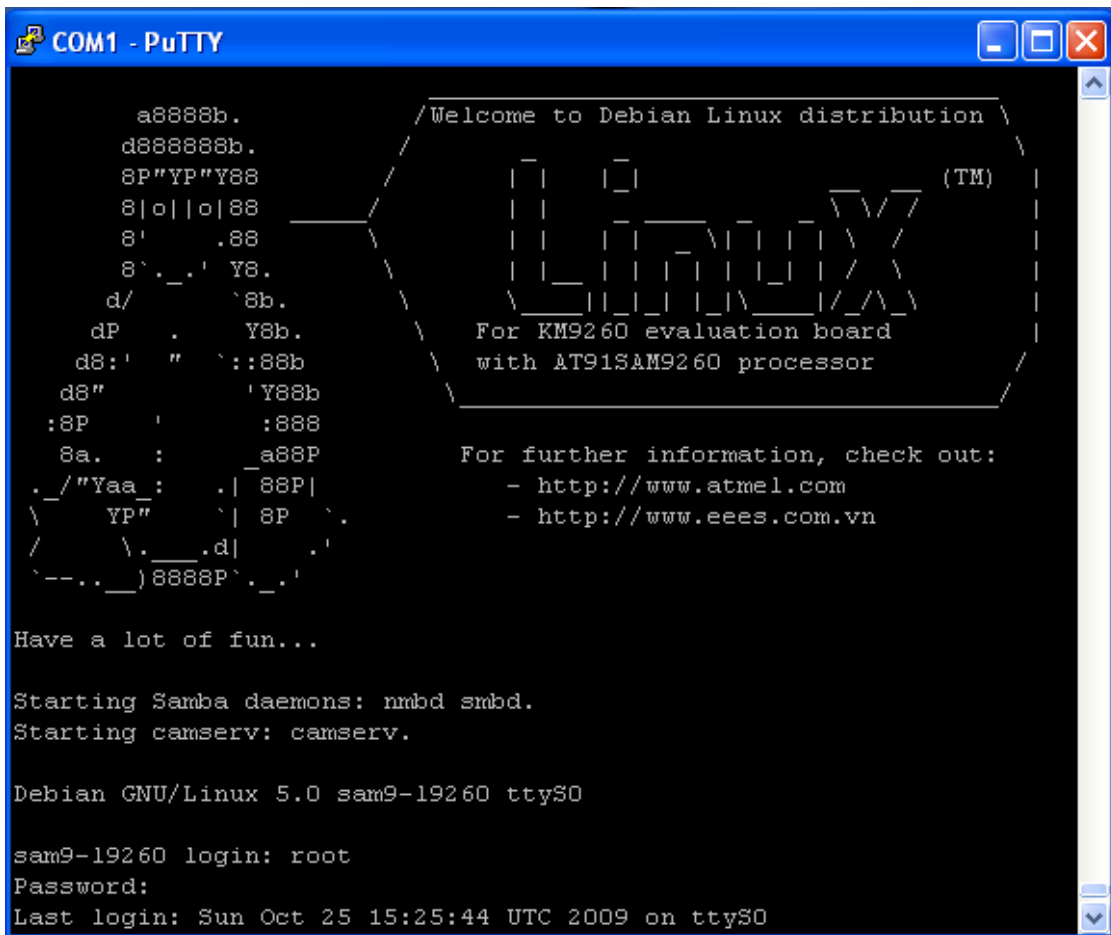


Figure: Debian Linux uses microSD

## COMPIING KERNEL :

We will show the steps for building Kernel Linux for KM9260.

### Toolchain (cross compiler):

```
$ tar -jxvf arm-2007q3.tar.bz2
```

Before we use the cross compiler, we have to add the “PATH” variation.

For example: the bin folder of cross compiler is in the address: “/home/km9260-project/tool/arm-2007q3/bin”. We add this address into PATH folder by the following commands:

```
$ export PATH=$PATH:/home/km9260-project/tool/arm-2007q3/bin
```

### Unzip and patch Kernel source:

In the root folder, we create “KM9260-project” folder and copy the source of linux-2.6.27.tar.bz2 and patch file “linux-2.6.27-km9260-11102009.diff” into this folder.

```
$ tar -jxvf kernel-2.6.27.tar.bz2
$ cd linux-2.6.27
$ cat ../linux-2.6.27-km9260-11102009.diff | patch -p1
```

### Configuration and building Kernel:

After patching, we can do configuration and building Kernel.

```
$ cd linux-2.6.27
$ make ARCH=arm CROSS_COMPILE=arm-none-linux-gnueabi- km9260_defconfig
$ make ARCH=arm CROSS_COMPILE=arm-none-linux-gnueabi- uImage
```

### Kernel menuconfig:

We can do configuration for kernel by the following:

```
$ cd linux-2.6.27
$ make ARCH=arm CROSS_COMPILE=arm-none-linux-gnueabi- menuconfig
```

### Load kernel and boot Linux:

After we compile the Kernel, we have the uImage file (in the arch/arm/boot folder of Kernel source). To boot Linux, we load uImage file into SDRAM by the way of LAN. Firstly, we copy uImage file into the /tftpboot folder of Linux PC (use tftp server) or into the shared folder of tftpd32.exe on winXP. We copy uImage file into SDRAM at the address: 0x20000000, then boot system.

```
$ tftp 0x20000000 uImage  
$ bootm 0x20000000
```