

Revision History
Rev. 1.1

Revision	Date	Description
1.0	2006/10/17	First Release
1.1	2007/9/10	M-501 V3 hardware modification Change the CN3 Pin 38 (PIO13) mapping from CPU's PC6 to PB22. Firmware is also changed accordingly to ensure 100% software compatibility with M-501 V2. Reason: ATMEL technical note suggests not to use PC6 as Digital I/O pin.

M501 Evaluation Kit User Guide

Overview

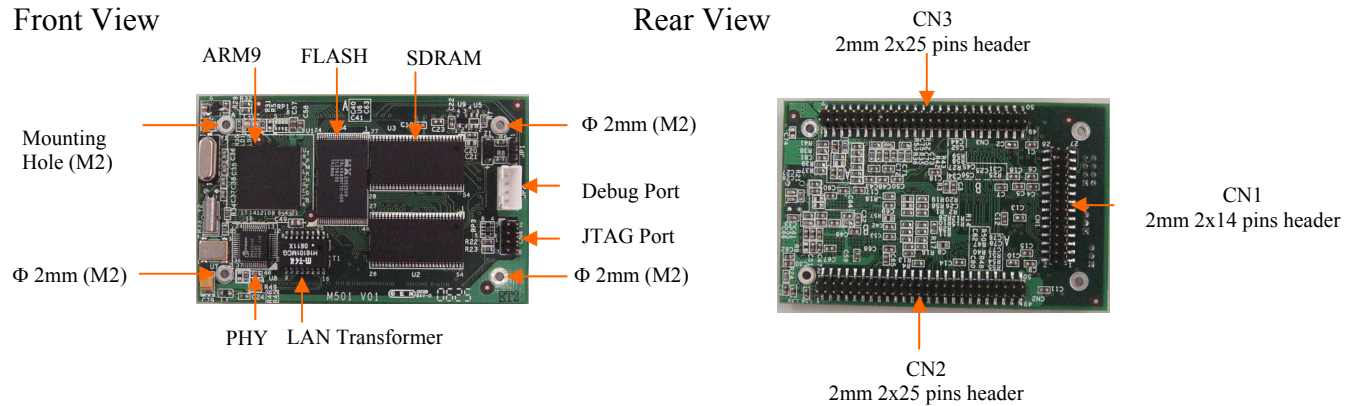
M501 is an ARM9-based Linux ready System on Module. The M501 is equipped with an ATMEL AT91RM9200 SoC and features:

1. ARM920T ARM Thumb Processor with 200MIPS at 180MHz, Memory Management Unit
2. 16-KByte Data Cache and 16-KByte Instruction Cache
3. 64MB SDRAM, 16MB Flash
4. One 10/100 Mbps Ethernet with MAC/PHY and transformer
5. Two USB 2.0 full speed (12 Mbps) Host Ports
6. Multimedia Card Interface for SD memory card
7. Four UARTs with hardware and software flow control
8. Two-wire Interface (I2C) for Real Time Clock
9. 32 Programmable Digital I/O Port
10. 8-bit external local bus interface

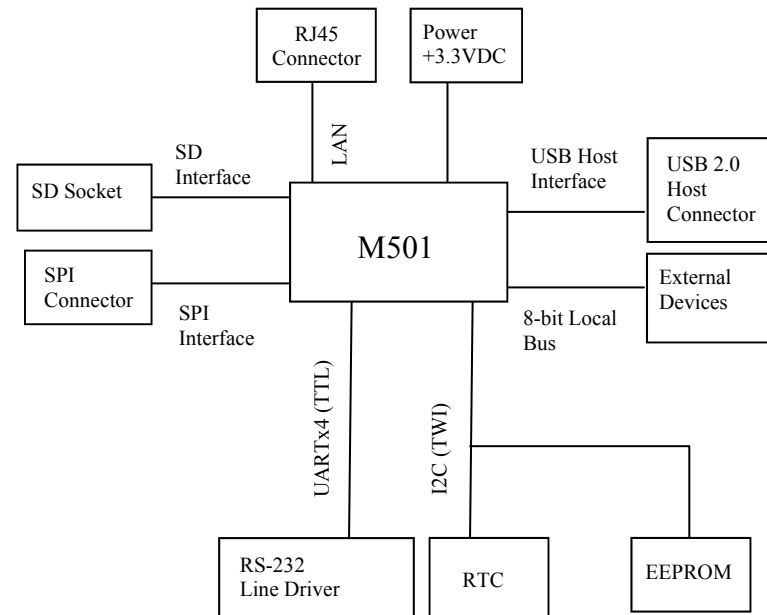
Linux 2.6 OS is pre-installed in the flash disk of M501 and many powerful utility programs are also included. GNU C/C++ tool chain are shipped with M501 in CD. Therefore, M501 is ready to drop in your design to save your time in software porting and hardware debug.

Artila uses M-501 to design Matrix-510/520. Please refer to Matrix-510/520 user guide and if you are interested in those design, please contact Artila.

M-501 Layout



Function Block Diagram



M501 Hardware Specifications

SoC: ATMEL AT91RM9200

CPU: ARM920T ARM Thumb Processor with Memory Management Unit (MMU)

Clock: 180MHz

SDRAM: 64MB

Flash: 16MB Intel StrataFlash or Equivalent

Ethernet: 10/100 Mbps with MAC/PHY and Transformer

PHY: DAVCOM DM9161

Transformer: 1.5 KV isolation

Signal: **ETX0+**, **ETX0-**, **ERX0+**, **ERX-**

USB : USB 2.0 full speed (12Mbps) Host x2

Signal: **UDataA+**, **UDataA-**, **UDataB+**, **UDataB-**

UART: Four Universal Asynchronous Receiver and Transmitter

Data Bits: 5 to 9 bits

Parity: None, Even, Odd, Mark, Space

Stop: 1, 1.5, 2 bits

Baud Rate: Up to 921.6 Kbps

Flow Control: RTS/CTS, XON/XOFF, None

Multi-drop Mode with address generation and detection (COM1 only)

RS485 Driver Control Signal (COM1:RTS0)

Signal Level: CMOS/3.3V compatible

COM1: **TXD0**, **RXD0**, **RTS0**, **CTS0** (RS485 Control: **RTS0**)

(Software configurable RS-232/422/485)

COM2: **TXD1**, **RXD1**, **RTS1**, **CTS1**, **DCD1**, **DTR1**, **DSR1**

(RS-232 with full modem control)

COM3: **TXD2**, **RXD2**, **RTS2**, **CTS2**

(RS-232 with hardware flow control)

COM4: **TXD3**, **RXD3**, **RTS3**, **CTS3**

(RS-232 with hardware flow control)

Inter-IC Bus: (I2C Bus)

Compatible with standard two-wire serial memory interface

Supported Devices: (Driver built-in)

Real Time Clock: Ricoh (RS5C372)

EEPROM: ATMEL AT24C16 and compatible

Signal: **TWD**, **TWDK**

I2S (internal IC Sound):

Transmitter: **TSCK**, **TWS**, **TSD**

Receiver: **RSCK**, **RWS**, **RSD**

Serial Peripheral Interface: (SPI)

Two chip Selects with external decoder

Three wires signals: MISO, MOSI and SPCK clock

Signal: **MISO**, **MOSI**, **SPCK**, **CS1**, **CS2**

Multimedia Card Interface

Compatible with SD memory card Specification 1.0

Signal: **MCCDA**, **MCCK**, **MCDA0**, **MCD A1**, **MCD A2**, **MCD A3**

Watchdog Timer: CPU built-in WDT and used by Linux Kernel

Programmable DIO

32 General Purpose IOs and can be programmable as digital input or output

Support interrupt function for digital inputs

Signal Level: CMOS/3.3V Compatible

Input:

Low level: -0.3V min

+0.8V max

High level: +2V min

+3.9V max

Output:

Low level: +0.4V max @0mA

+0.2V min @ 8mA

High level: +3.1V max @0mA

+2.9V min @ 8mA

Signal: **PIO0 to PIO31**

External Bus Interface:

8-bit data bus

Signal: **D0~D7**

8-bit address bus

Signal: **A0~A7**

4 Chip Selection

Signal: **NCS3~NCS6**

Signal Level: CMOS/3.3V

Predefine Pins:

Reset Button (CN2, pin#35, **RST#1**), input

Buzzer (CN2, pin#37, **BUZR**), output

System ready LED (CN2, pin#38, **RDY_LED**), output

LAN activity LED (CN3, pin#11, **ACT_LED**), output

Undefined Digital IO Pins (reserved)

CN1: pin#23, #24, #25, #26

CN3: pin#23, #24

Debug Port:

Serial Console: Tx/Rx

Signal: **Tx** share with **RTS2**

Rx share with **CTS2**

JTAG: For low level debug

Signal: **NTRST**, **TDI**, **TMS**, **TCK**, **TDO**

Power:

Input: 3.0 to 3.6VDC (3.3V nominal)

Consumption: 2.5W

M501 Software Specifications

OS: Linux 2.6.14
Boot Loader: U-Boot 1.1.2
File System: JFFS2, EXT2/EXT3, VFAT/FAT, NFS
Protocol Stacks:
IPV4, ICMP, ARP, DHCP, NTP, TCP, UDP, FTP, Telnet, HTTP, PPP,
PPPoE, CHAP, PAP, SMTP, SNMP V1/V3, SSL, SSH 1/2
Utilities:

Bash: Shell Command
Tinylogin: Login and user manager utility
Telnet: Telnet client program
Busybox: Linux utility collection
FTP: FTP client program

Daemon

pppd: Dial In/out over serial port and PPPoE
snmpd: SNMP agent program
telnetd: Telnet server program
inetd: TCP server program
ftpd: FTP server program
boa: Web server program
sshd: secured shell server
iptables: Firewall service manager
armd: Artila manager daemon

Tool Chain for Windows/Linux
GCC: C/C++ PC cross compiler
GLIBC: POSIX Library
Standard Device Drivers:
ttyS0: serial console port (AT91RM9200 debug port)
ttyS1~ttyS4: serial ports (AT91RM9200 UART0~UART3)
gpio: General Purpose I/O
mmc: SD/MMC:
rtc: Real Time Clock
sda: USB flash memory disk
ttyACM: USB Modem
ttyUSB: USB RS-232 adaptor
spi: spi bus

Default Setting

Default IP Address:192.168.2.127
Netmask: 255.255.255.0
ssh Login: root
Password: root
Telnet Login: guest
Password: guest
Terminal type: VT100

Network Configuration

To configure the IP address, Netmask and Gateway setting, please modify
/disk/etc/rc as following:

#Static IP
ifconfig eth0 192.168.2.127 netmask 255.255.255.0

For DHCP setting:

#DHCP
dhcpcd eth0 &

Wireless LAN Configuration

M-501 supports wireless LAN by using USB WLAN adaptor which uses Ralink RT2571 controller. Please refer to the website
<http://ralink.rapla.net> for the supporting list of the USB WLAN adaptor. To configure the wireless LAN setting, please use command:

ifconfig wlan0 up
iwconfig wlan0 essid XXXX key YYYYYYYY mode MMMM

For infrastructure mode XXXX is the access point name and YYYYYYYY is the encryption key and MMMM should be **managed**

For Ad-Hoc mode mode XXXX is the M-501 device name and YYYYYYYY is the encryption key MMMM should be **ad-hoc**. To configure the IP address use command
dhcpcd wlan0 & or ifconfig wlan0 192.168.2.127 netmask 255.255.255.0

Install GNU Tool Chain

Find a PC with Linux 2.6.X Kernel installed and login as a **root** user then copy the arm-linux-3.3.2.tar.gz to root directory \ of PC. Under \ directory type following command to install the M-501 Tool Chain

#tar zxvf arm-linux-3.3.2.tar.gz

I/O Devices Control

M-501 uses standard I/O device control to access following devices:

1. Ethernet: eth0
2. Serial Ports: ttyS1, ttyS2, ttyS3, ttyS4
3. Serial Console Port: ttyS0
4. Real time clock: rtc
5. USB Flash Disk: sda, sda1, sdb, sdb1
6. SD memory Card: mmc0
7. USB WLAN dongle: wlan0
8. USB Serial Cable: ttyUSB0, ttyUSB1
9. SPI bus: spi0, spi1

Remark: Remember to include the "matrix500.h" header file in your program. Please refer to the example program included in the M-501 SDK CD to demo the RS-232/422/485 mode configuration of serial port 1 configuration.

File System

Matrix 500 uses jffs2 file system for the built-in flash memory disk. The directory are:
/disk
/home
/etc

Write data to these directories are saved to flash memory and will not be erased after power off.

Mount External Disk

To mount the USB Flash Disk and SD memory card, use following commands after the disk are installed properly. To mount USB disk
mount /mnt/sda or **mount /mnt/sda1** or **mount /mnt/sdb** or **mount /mnt/sdb1**

To find out the device name of the USB disk, you can use
dmesg | grep sd

And to mount SD memory card
mount /mnt/mmc

Web Page Directory

The web pages are placed at /home/httpd and the boa.conf contains the boa web server settings. The home page name should be **index.html**

Welcome Message

The welcome message "Artila" can be modified by editing the **/etc/motd** file.

Manager Utility Software

The Manager Utility software, **manager.jar** is a java program and is used to discovered the Matrix 500 in the network if the IP address is forgotten. It can be run at any OS where java run time is available. To install the java run time platform at your computer, please visit <http://java.sun.com> and download the Java 2 Standard Edition (J2SE). Once the Matrix 500 is found, you can click the Telnet Console to configure the Matrix 500

Upload file to M-501

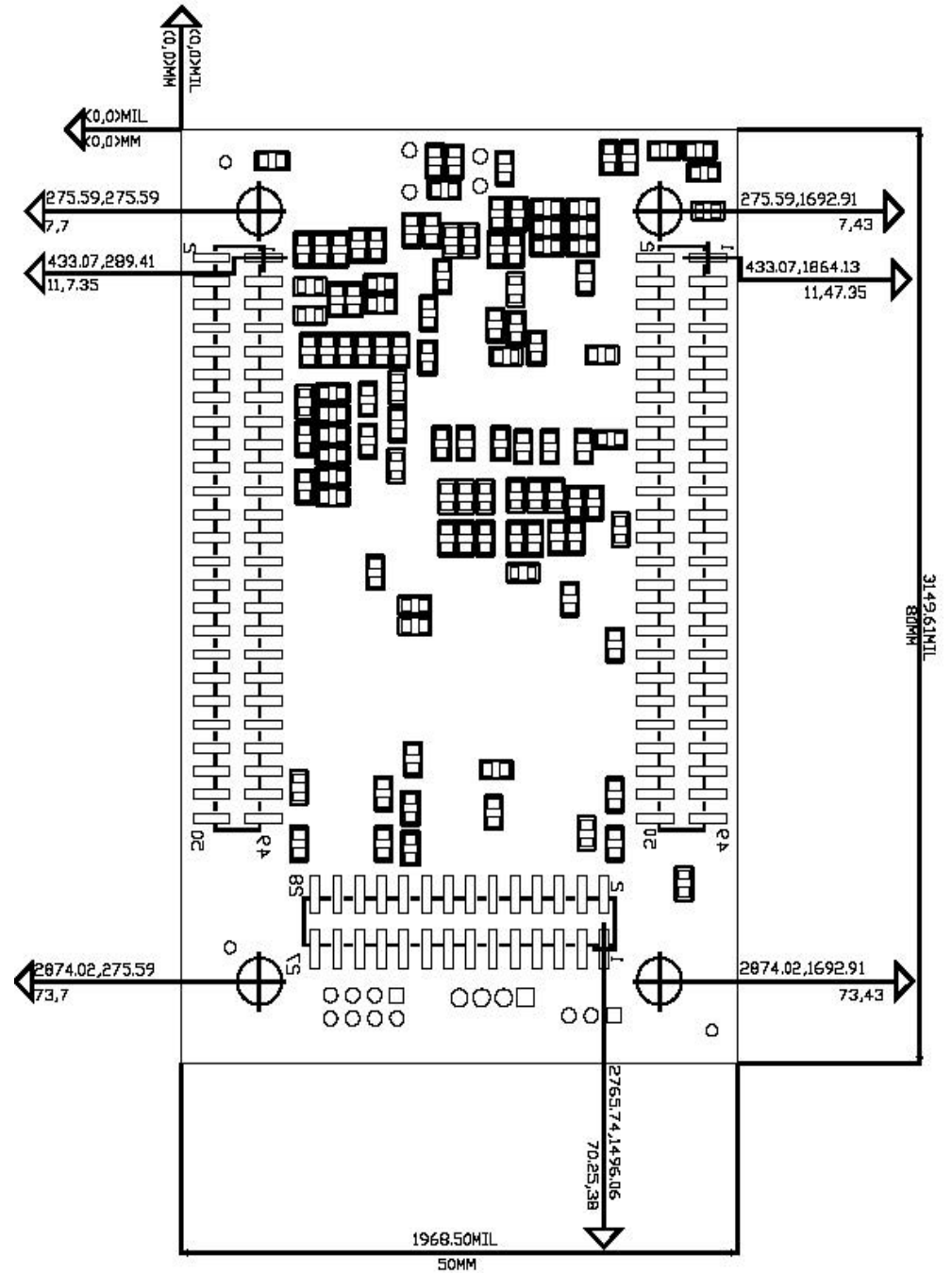
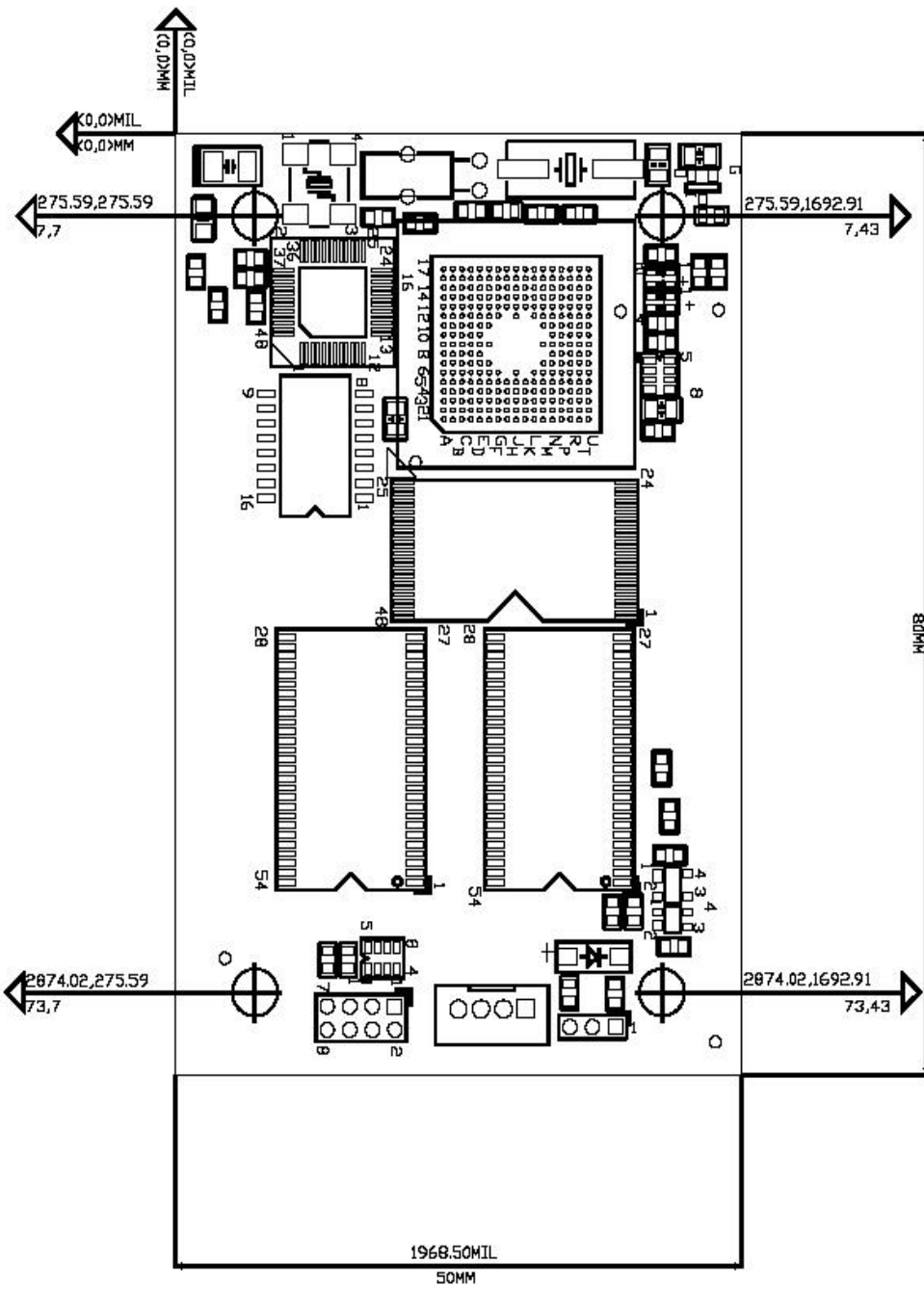
To upload the file to M-501, you can use FTP command in command line or Web Browser such as Microsoft Internet Explorer. Type **ftp://192.168.2.127** and under the file menu, click log on option to login M-501. After login, you can see the files system of M-501.

Compile and upload the C program

Use following command of the GNU cross compiler to compile the C program
#arm-linux-gcc -o hello hello.c

Then upload the **hello** to M-501. Remember to change the mode of the file After upload to M-501 by
chmod +x hello

M501 Mechanical Dimension



Pin Assignment and Definition

Function	CPU	SoM	SoM	CPU	Function
CN1					
(Addr Bus)	A0	1	2	D0	(Data Bus)
(Addr Bus)	A1	3	4	D1	(Data Bus)
(Addr Bus)	A2	5	6	D2	(Data Bus)
(Addr Bus)	A3	7	8	D3	(Data Bus)
(Addr Bus)	A4	9	10	D4	(Data Bus)
(Addr Bus)	A5	11	12	D5	(Data Bus)
(Addr Bus)	A6	13	14	D6	(Data Bus)
(Addr Bus)	A7	15	16	D7	(Data Bus)
(Write Enable)	NWE NWR0	17	18	NOE NRD	(Read Enable)
(Chip Select)	NCS3	CS3 19	20	CS4	NCS4 (Chip Select)
(Chip Select)	NCS5	CS5 21	22	CS6	NCS6 (Chip Select)
(N/A)	PA21	23	24	PA24	(N/A)
(N/A)	PB7	25	26	PB18	(N/A)
	VCC3	27	28	GND	
CN1					

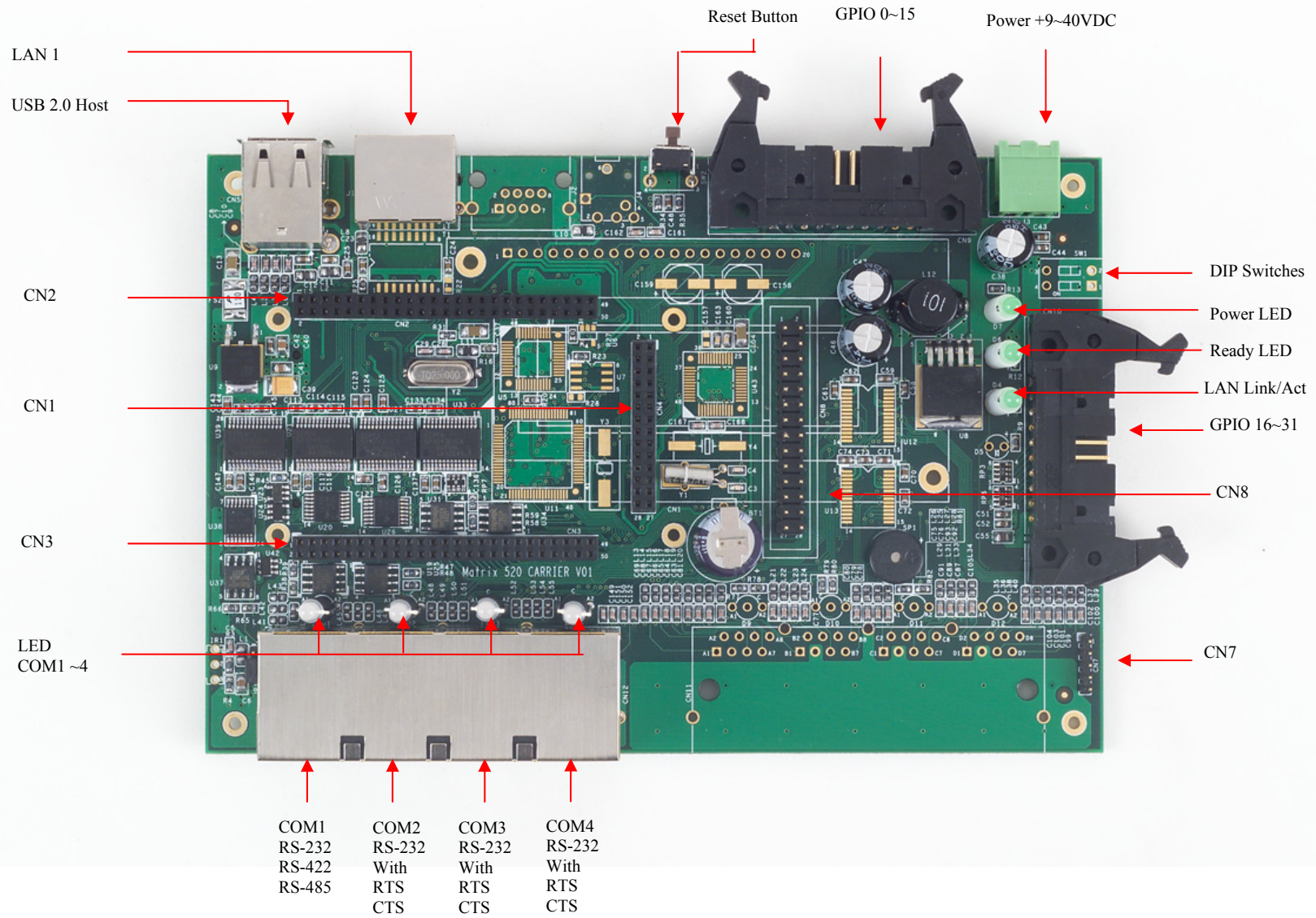
Pin Assignment and Definition

Function	CPU	SoM	SoM	CPU	Function
CN2					
(COM2)	CTS2	1	2	DSR2	(COM2)
(COM2)	RTS2	3	4	RXD3	(COM3)
(COM3)	TXD3	5	6	CTS3	(COM3)
(COM3)	RTS3	7	8	TXD4	(COM4)
(COM4)	RXD4	9	10	RTS4	(COM4)
(COM4)	CTS4	11	12	PD22	(GPIO)
(GPIO)	PD23	13	14	PIO16	PC14 (GPIO)
(GPIO)	PC15	PIO17	15	PIO18	PD7 (GPIO)
(GPIO)	PD8	PIO19	17	PIO20	PD9 (GPIO)
(GPIO)	PD10	PIO21	19	PIO22	PD11 (GPIO)
(GPIO)	PD12	PIO23	21	PIO24	PD13 (GPIO)
(GPIO)	PD14	PIO25	23	PIO26	PD15 (GPIO)
(GPIO)	PD16	PIO27	25	PIO28	PD17 (GPIO)
(USB B+)	HDPB	UdataB+	27	UdataB-	HDMB (USB B-)
(USB A-)	HDMA	UdataA-	29	UdataA+	HDP A (USB A+)
(GPIO)	PD18	PIO29	31	PIO30	PD26 (GPIO)
(GPIO)	PD27	PIO31	33	VCC3 PWROK	(System Reset)
(Reset Btn)	BTNRST#	35	36	NTRST	(JTAG Reset)
(Buzzer)	PB6	37	38	PD6	(System Ready LED)
(I2S transmitter)	TF2	TWS	39	TSCK	TK2 (I2S transmitter)
(I2S transmitter)	TD2	TSD	41	RSD	RD2 (I2S receiver)
(I2S receiver)	RK2	RSCK	43	RWS	RF2 (I2S receiver)
	GND	45	46	GND	
	GND	47	48	GND	
	VCC3	49	50	VCC3	
CN2					

Pin Assignment and Definition

Function	CPU	SoM	SoM	CPU	Function
CN3					
	VCC3	1	2	VCC3	
	GND	3	4	GND	
	GND	5	6	GND	
(LAN)	ERX0-	7	8	ERX0+	(LAN)
(LAN)	ETX0-	9	10	ETX0+	(LAN)
(LAN LED)		ACTLED#	11	MISO	(SPI)
(SPI)	MOSI		13	SPCK	(SPI)
(SPI)	NPCS0		15	NPCS1	(SPI)
(SD)	MCCK		17	MCCDA	(SD)
(SD)	MCDA0		19	MCDA1	(SD)
(SD)	MCDA2		21	MCDA3	(SD)
(N/A)	PD19		23	PD20	(N/A)
(I2C)	TWD		25	TWCK	(I2C)
(GPIO)	PA19	PIO1	27	PIO3	PB2 (GPIO)
(GPIO)	PB8	PIO4	29	PIO5	PB9 (GPIO)
(GPIO)	PB10	PIO6	31	PIO7	PB11 (GPIO)
(GPIO)	PC0	PIO8	33	PIO9	PC1 (GPIO)
(GPIO)	PC2	PIO10	35	PIO11	PC3 (GPIO)
(GPIO)	PC5	PIO12	37	PIO13	PB22 (GPIO)
(GPIO)	PB28	PIO14	39	PIO15	PB29 (GPIO)
(GPIO)	PD24	PIO0	41	PIO2	PD25 (GPIO)
(COM1)	TXD1		43	RXD1	(COM1)
(COM1)	CTS1		45	RTS1	(COM1)
(COM2)	DTR2		47	TXD2	(COM2)
(COM2)	RXD2		49	DCD2	(COM2)
CN3					

M501 Evaluation Board Layout



Enable Serial Console Port

Step 1: M-501 serial console port (ttyS0) shares three data pins with serial port P3 (RS-232 port ttyS3).

ttyS0. Tx <=> ttyS3. RTS
 ttyS0. Rx <=> ttyS3. CTS
 ttyS0.GND <=> ttyS3. GND

Connect the Console cable to Port 3 and the serial port of your computer

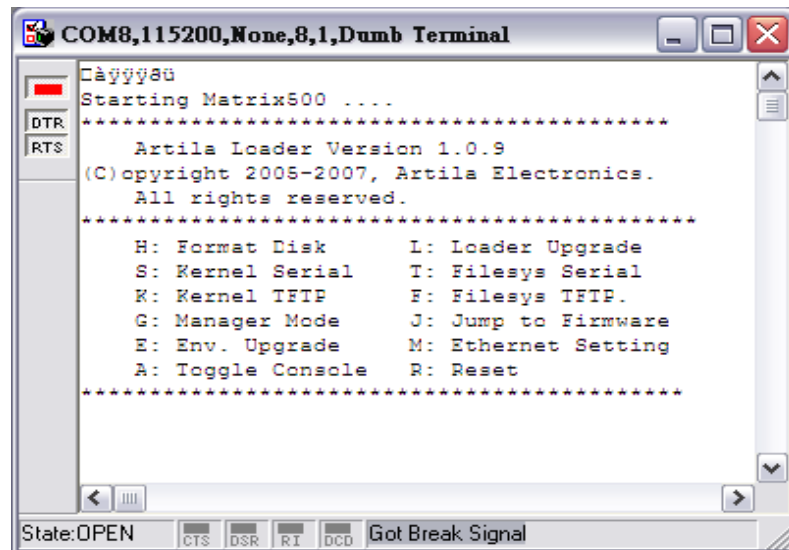
Console Port via P3 Connector

Pin	RS-232
1	
2	TXD
3	GND
4	
5	
6	
7	RXD
8	

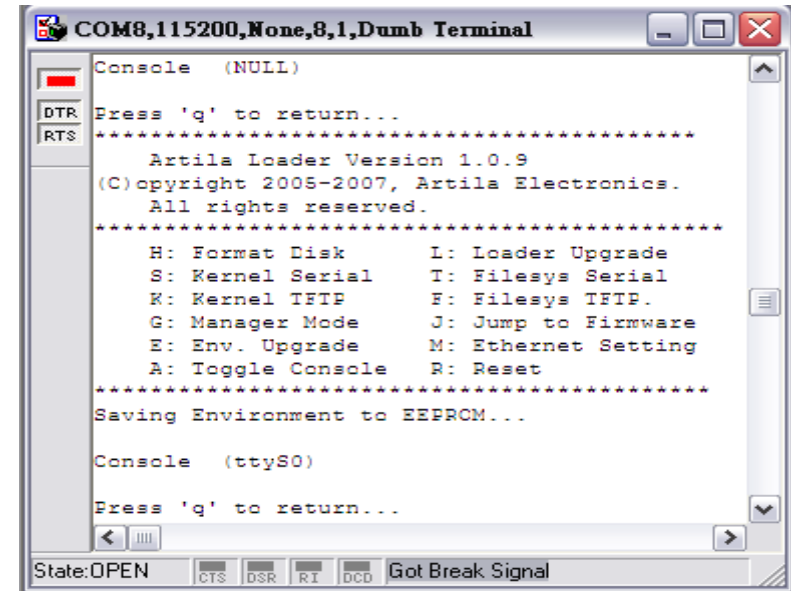
Step 2: Once the serial console (ttyS0) are connected correctly to your PC, you need to use a terminal software such as hyper terminal of Microsoft and the serial port setting as 115200,N,8,1 and no flow control. Terminal type is VT100.

Step 3: Power on M-501 then you will see the message from your terminal software as follow:

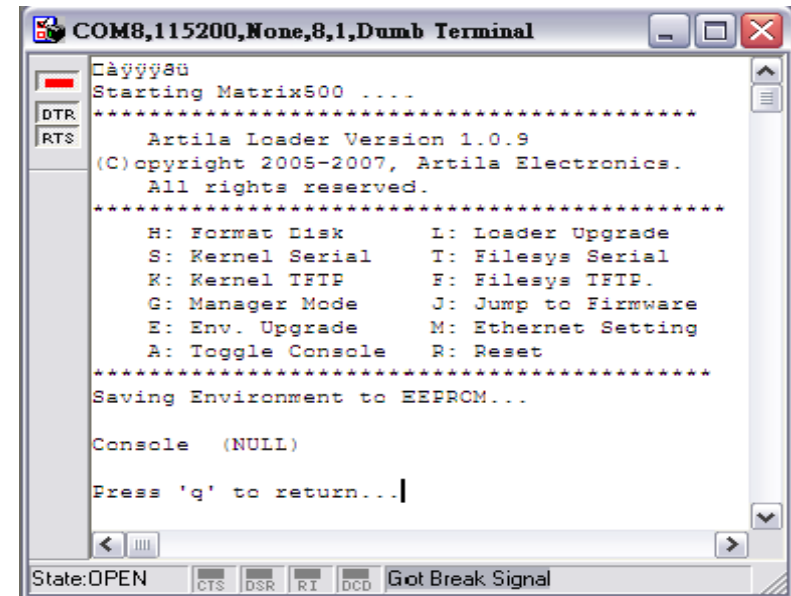
Once “Starting Matrix 500” appears, please keep typing “@” to trigger the serial load program. Then you will see the Artila loader menu appear. If you miss the trigger procedure, please reset the M501 and repeat step 3 again.



Step 4: Now you can type “A” to enable the serial console function. Once you see the console is enabled as follow, Press “q” to return to main menu of console. Then please type ”R” to reboot the system.



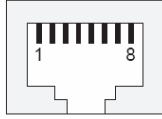
Step 5: Once you complete system debug, please remember to disable the serial console using the Toggle Console item by typing “A”..



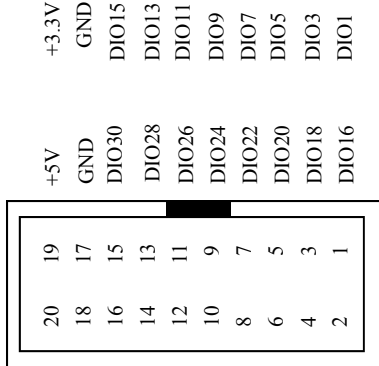
Pin Assignment of Connectors

LAN 1 and LAN2

Pin	Signal
1	ETx+
2	ETx-
3	ERx+
6	ERx-

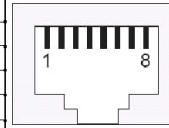


GPIO Port 0~15 and GPIO Port 16

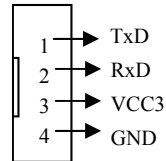


COM Port

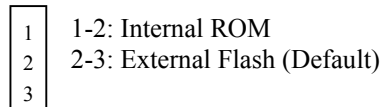
Pin	RS-232	RS-422	RS-485
1	---	---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6	---	RXD-	---
7	CTS	---	---
8	---	---	---



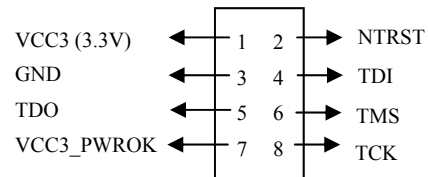
JP2 Serial Console Port



JP1 of M501 Boot Mode Selection Jumper

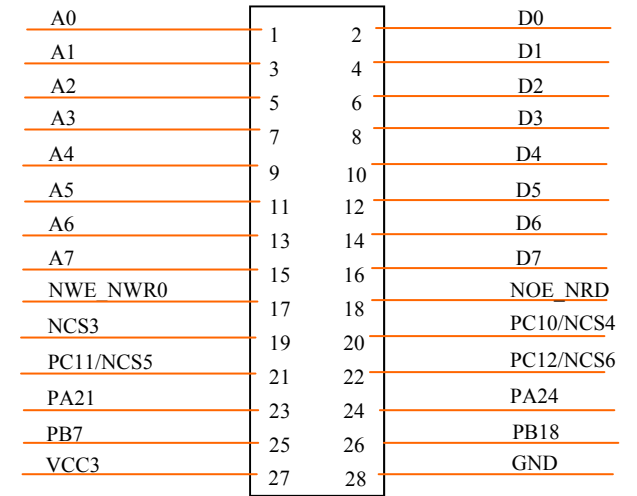


CN4 JTAG Connector



CN8 Local Bus Connector

- 1x14 Pin Header Pitch 2.54mm
- CN8 directly connect to CN1 of M501



CN7 (SPI) Pin Assignment

