

# M502 Evaluation Kit User Guide

## Overview

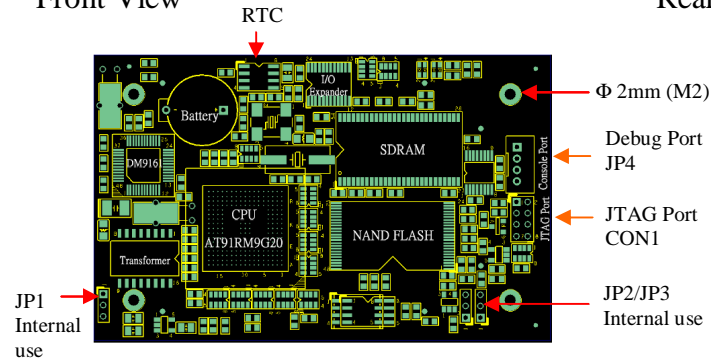
M502 is an ARM9-based Linux ready System on Module. The M502 is equipped with an ATMEL AT9SAM9G20 SoC and features:

1. ARM926EJ-S ARM Thumb Processor with 400MHz, Memory Management Unit
2. 32-KByte Data Cache and 32-KByte Instruction Cache
3. 64MB SDRAM, 128MB NAND Flash, 2MB DataFlash
4. One 10/100 Mbps Ethernet with MAC/PHY and transformer
5. Two USB 2.0 full speed (12 Mbps) Host Ports, One USB client port
6. Multimedia Card Interface for SD memory card
7. Four UARTs with hardware and software flow control
8. On board Real Time Clock with Lithium battery
9. I2C bus
10. 32 Programmable Digital I/O Port
11. 8-bit external local bus interface
12. Serial Peripheral Interface (SPI) Ports
13. Linux 2.6.29 OS

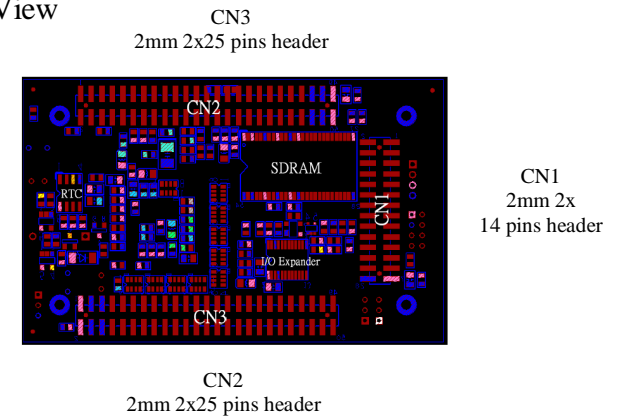
Linux 2.6.29 OS is pre-installed in the flash disk of M502 and many powerful utility programs are also included. GNU C/C++ tool chain are shipped with M502 in CD. Therefore, M502 is ready to drop in your design to save your time in software porting and hardware debug.

## M-502 Layout

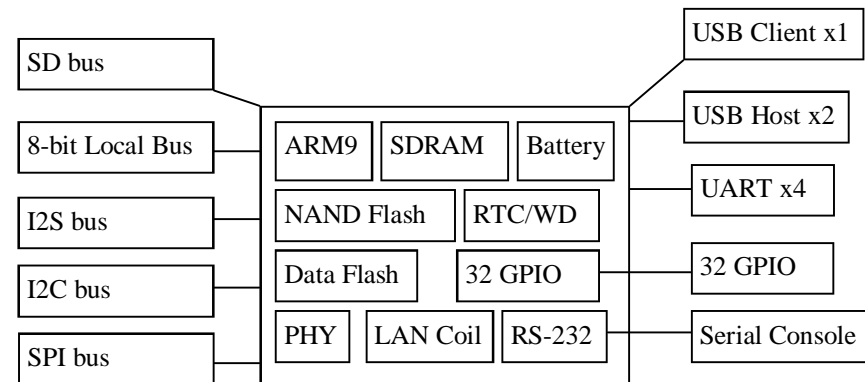
Front View



Rear View



## Function Block Diagram



## M502 Hardware Specifications

**SoC:** ATMEL AT91SAM9G20

**CPU:** ARM926EJ-S ARM Thumb Processor with Memory Management Unit (MMU)

**Clock:** 400MHz

**SDRAM:** 64MB

**Flash:** 128MB NAND Flash and 2MB Data Flash

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

PHY: DAVCOM DM9161

Transformer: 1.5 KV isolation

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

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

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

**USB Device:** *DDP (data+)*, *DDM (data-)*, *UDIO (I/O)*

**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

RS485 Driver Control Signal (RTS0~RTS3)

Signal Level: CMOS/3.3V compatible

COM1: *TXD0*, *RXD0*, *RTS0*, *CTS0*

(Software configurable RS-232/485 mode)

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

(Software configurable RS-232/485 mode)

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

(Software configurable RS-232/485 mode)

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

(Software configurable RS-232/485 mode)

**Inter-IC Bus: (I2C Bus)**

Compatible with standard two-wire serial memory interface

Supported Devices: (built-in)

Real Time Clock: ST M41T81 (option:Ricoh RS5C372A)

Watchdog Timer: ST M41T81

Backup battery: Lithium Battery (BR 1225 3V 48mAh)

GPIO controller: NXP PCA9539 (32 GPIO)

Signal: *TWD*, *TWDK*

**I2S (internal IC Sound):**

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

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

Supported Device: Audio codec TI TLV320AIC23

**Serial Peripheral Interface: (SPI)**

Two chip Selects with external decoder

Three wires signals: MISO, MOSI and SPCK clock

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

Supported Device: ATMEL Dataflash

**Multimedia Card Interface**

Compatible with SD memory card Specification 1.0

Signal: *MCCDA*, *MCCK*, *MCD A0*, *MCD A1*, *MCD A2*, *MCD A3*

**Programmable DIO ( I/O Controller NXP PCA9539)**

32 General Purpose I/O can be programmable as digital input or output

Signal Level: CMOS/TTL Compatible

Input:

Low level: -0.5V min

+0.9V max

High level: +2.3V min

+5.5V max

Output:

Low level: +0.5V min @ 8mA

High level: +1.8V min @ 8mA

Signal: *I/O\_0* to *I/O\_31*

**Note:** *PIO24* to *PIO31* are reserved for RS-232/422/485 interface selection for serial ports 1 to 4. Please contact Artila if you want to use *PIO24* to *PIO31*.

**External Bus Interface:**

8-bit data bus

Signal: *D0~D7*

8-bit address bus

Signal: *A0~A7*

3 Chip Selection

Signal: *NCS0/NCS5/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

DIP\_SW0, DIP\_SW1, input

**Debug Port: JP4**

Serial Console: RS-232 TX/RX

Signal: *DTXD\_232*, *DRXD\_232*

JTAG: For low level debug

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

**Power:**

Input: 3.0 to 3.6VDC (3.3V nominal)

Consumption: 2.5W

## M502 Software Specifications

OS: Linux 2.6.29  
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: Artilla manager daemon

### Tool Chain for Windows/Linux

GCC: C/C++ PC cross compiler

GLIBC: POSIX Library

### Standard Device Drivers:

ttyS0: serial console port (AT91SAM9G20 debug port)

ttyS1~ttyS4: serial ports (AT91SAM9G20

UART0~UART3)

gpio: General Purpose I/O ( Controller NXP PCA9539)

mmc: SD/MMC:

rtc: Real Time Clock (ST m41t81)

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**

### I/O Devices Control

M-502 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: rtc0
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 “matrix504.h” header file in your program. Please refer to the example program included in the M-502 SDK CD to demo the RS-232/422/485 mode configuration of serial port 1 configuration.

### File System

Matrix 504 uses ubi file system for the built-in flash memory disk. The files system is stored at NAND flash memory.

### 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 /usr/www and the /etc/lighttpd.conf contains the lighttpd web server settings. The home page name should be ***index.html***

### Welcome Message

The welcome message “Artilla” 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 504 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

**Note: Please refer to the software guide for the software operation!!**

## Pin Assignment and Definition

Function	CPU	SoM	SoM	CPU	Function
<b>CN1</b>					
(Addr Bus)	<b>A0</b>	1	2	<b>D0</b>	(Data Bus)
(Addr Bus)	<b>A1</b>	3	4	<b>D1</b>	(Data Bus)
(Addr Bus)	<b>A2</b>	5	6	<b>D2</b>	(Data Bus)
(Addr Bus)	<b>A3</b>	7	8	<b>D3</b>	(Data Bus)
(Addr Bus)	<b>A4</b>	9	10	<b>D4</b>	(Data Bus)
(Addr Bus)	<b>A5</b>	11	12	<b>D5</b>	(Data Bus)
(Addr Bus)	<b>A6</b>	13	14	<b>D6</b>	(Data Bus)
(Addr Bus)	<b>A7</b>	15	16	<b>D7</b>	(Data Bus)
(Write Enable)	<b>NWE NWR0</b>	17	18	<b>NRD</b>	(Read Enable)
(USB-Device-)	<b>DDM</b>	<b>DDM</b> 19	20	<b>CS5</b>	<b>NCS5</b> (Chip Select)
(Chip Select)	<b>NCS6</b>	<b>CS6</b> 21	22	<b>CS0</b>	<b>NCS0</b> (Chip Select)
(USB-Device+)	DDP	<b>DDP</b> 23	24		IRQ0 (Interrupt 0)
(Console TXD)	DTXD_232	25	26		DRXD-232 (Console RXD)
	VCC3	27	28		GND
<b>CN1</b>					

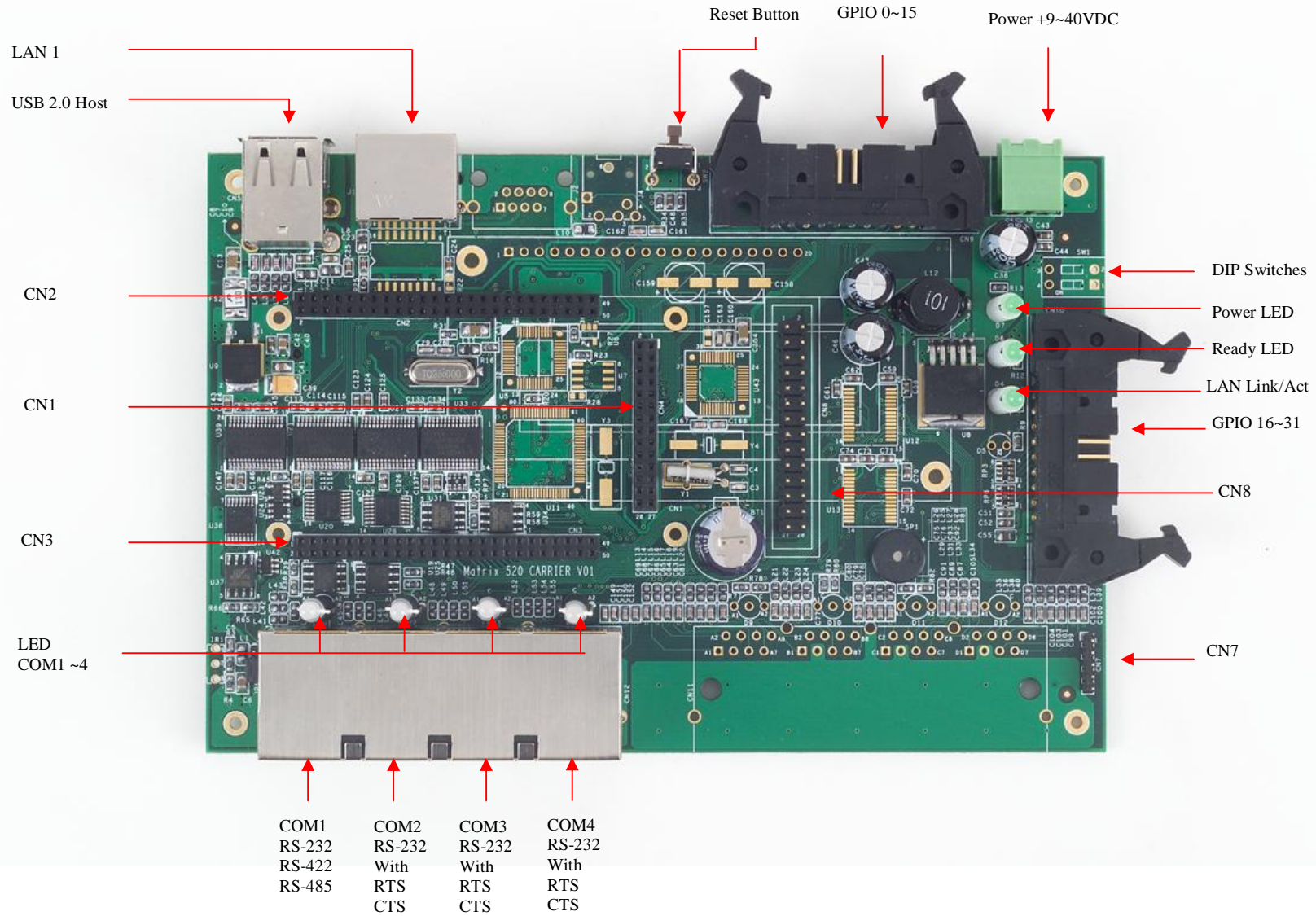
## Pin Assignment and Definition

Function	CPU	SoM	SoM	CPU	Function	
		<b>CN2</b>				
(COM2)	<b>CTS2</b>	1	2	<b>DSR2</b>	(COM2)	
(COM2)	<b>RTS2</b>	3	4	<b>RXD3</b>	(COM3)	
(COM3)	<b>TXD3</b>	5	6	<b>CTS3</b>	(COM3)	
(COM3)	<b>RTS3</b>	7	8	<b>TXD4</b>	(COM4)	
(COM4)	<b>RXD4</b>	9	10	<b>RTS4</b>	(COM4)	
(COM4)	<b>CTS4</b>	11	12	<b>DIP_SW</b>	(DIP_SW)	
(DIP_SW)	<b>PB13</b>	<b>DIP_SW</b>	13	14	<b>PIO16</b>	I/O_16 (GPIO)
(GPIO)	I/O_17	<b>PIO17</b>	15	16	<b>PIO18</b>	PC1/PCK0 (GPIO)
(GPIO)	I/O_19	<b>PIO19</b>	17	18	<b>PIO20</b>	I/O_20 (GPIO)
(GPIO)	I/O_21	<b>PIO21</b>	19	20	<b>PIO22</b>	I/O_22 (GPIO)
(GPIO)	I/O_23	<b>PIO23</b>	21	22	<b>PIO24</b>	I/O_24 (GPIO)
(GPIO)	I/O_25	<b>PIO25</b>	23	24	<b>PIO26</b>	I/O_26 (GPIO)
(GPIO)	I/O_27	<b>PIO27</b>	25	26	<b>PIO28</b>	I/O_28 (GPIO)
(USB B+)	<b>HDPB</b>	<b>UdataB+</b>	27	28	<b>UdataB-</b>	<b>HDMB</b> (USB B-)
(USB A-)	<b>HDMA</b>	<b>UdataA-</b>	29	30	<b>UdataA+</b>	<b>HDP A</b> (USB A+)
(GPIO)	I/O_29	<b>PIO29</b>	31	32	<b>PIO30</b>	I/O_30 (GPIO)
(GPIO)	I/O_31	<b>PIO31</b>	33	34	<b>VCC3 PWROK</b>	(System Reset)
(Reset Btn)	<b>BTNRST#</b>		35	36	<b>UDIO</b>	(USB-Device I/O)
(Buzzer)	PA26	<b>BUZR</b>	37	38	PC6	(System Ready LED)
(I2S transmitter)	<b>TF0</b>	<b>TWS</b>	39	40	<b>TSCK</b>	<b>TK2</b> (I2S transmitter)
(I2S transmitter)	<b>TD0</b>	<b>TSD</b>	41	42	<b>RSD</b>	<b>RD2</b> (I2S receiver)
(I2S receiver)	<b>RK0</b>	<b>RSCK</b>	43	44	<b>RWS</b>	<b>RF2</b> (I2S receiver)
	GND		45	46	GND	
	GND		47	48	GND	
	VCC3		49	50	VCC3	
		<b>CN2</b>				

## Pin Assignment and Definition

Function	CPU	SoM	SoM	CPU	Function
<b>CN3</b>					
	VCC3	1	2	VCC3	
	GND	3	4	GND	
	GND	5	6	GND	
(LAN)	<b>ERX0-</b>	7	8	<b>ERX0+</b>	(LAN)
(LAN)	<b>ETX0-</b>	9	10	<b>ETX0+</b>	(LAN)
(LAN LED)		ACTLED#	11	<b>MISO</b>	(SPI)
(SPI)	<b>MOSI</b>		13	<b>SPCK</b>	(SPI)
(SPI)	<b>NPCS0</b>		15	<b>NPCS3</b>	(SPI)
(SD)	<b>MCCK</b>		17	<b>MCCDA</b>	(SD)
(SD)	<b>MCDA0</b>		19	<b>MCDA1</b>	(SD)
(SD)	<b>MCDA2</b>		21	<b>MCDA3</b>	(SD)
(Card Detect)	SDCD		23	SDWP	(SD Write Protect)
(I2C)	<b>TWD</b>		25	<b>TWCK</b>	(I2C)
(GPIO)	I/O_1	<b>PIO1</b>	27	<b>PIO3</b>	I/O_3 (GPIO)
(GPIO)	I/O_4	<b>PIO4</b>	29	<b>PIO5</b>	I/O_5 (GPIO)
(GPIO)	I/O_6	<b>PIO6</b>	31	<b>PIO7</b>	I/O_7 (GPIO)
(GPIO)	I/O_8	<b>PIO8</b>	33	<b>PIO9</b>	I/O_9 (GPIO)
(GPIO)	I/O_10	<b>PIO10</b>	35	<b>PIO11</b>	I/O_11 (GPIO)
(GPIO)	I/O_12	<b>PIO12</b>	37	<b>PIO13</b>	I/O_13 (GPIO)
(GPIO)	I/O_14	<b>PIO14</b>	39	<b>PIO15</b>	PC15 (GPIO)
(GPIO)	I/O_0	<b>PIO0</b>	41	<b>PIO2</b>	I/O_2 (GPIO)
(COM1)	<b>TXD1</b>		43	<b>RXD1</b>	(COM1)
(COM1)	<b>CTS1</b>		45	<b>RTS1</b>	(COM1)
(COM2)	<b>DTR2</b>		47	<b>TXD2</b>	(COM2)
(COM2)	<b>RXD2</b>		49	<b>DCD2</b>	(COM2)
<b>CN3</b>					

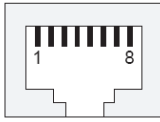
# M501 Evaluation Board Layout



# Pin Assignment of Connectors

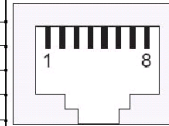
## LAN 1

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



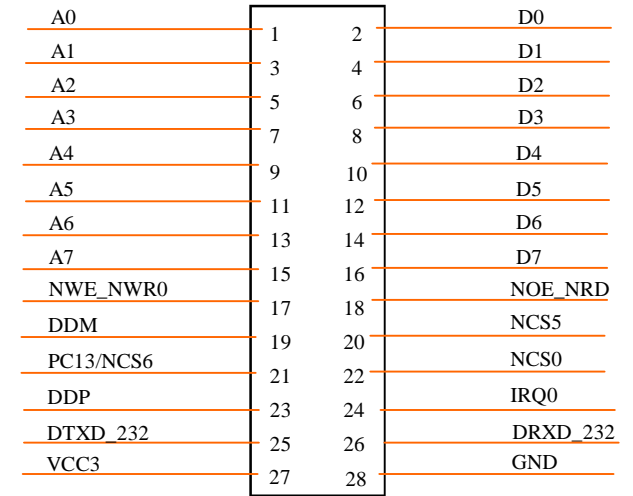
## COM Port

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	---	---	---

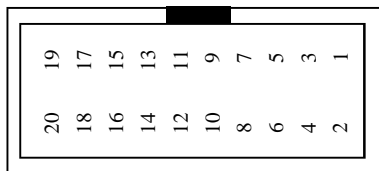
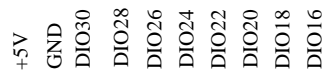
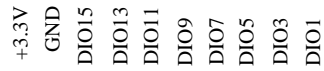


## CN8 Local Bus Connector

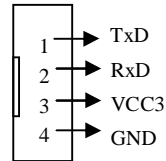
- 1x14 Pin Header Pitch 2.54mm
- CN8 directly connect to CN1 of M501



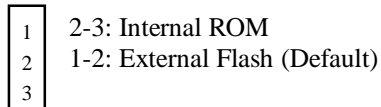
## GPIO Port 0~15 and GPIO Port 16



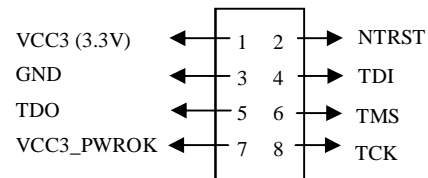
## JP4 Serial Console Port



## JP1 of M502 Boot Mode Selection Jumper



## CON1 JTAG Connector



## CN7 (SPI) Pin Assignment

