

M-502

Linux ARM9 System on Module

User Guide

Version 1.0



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1. Introduction

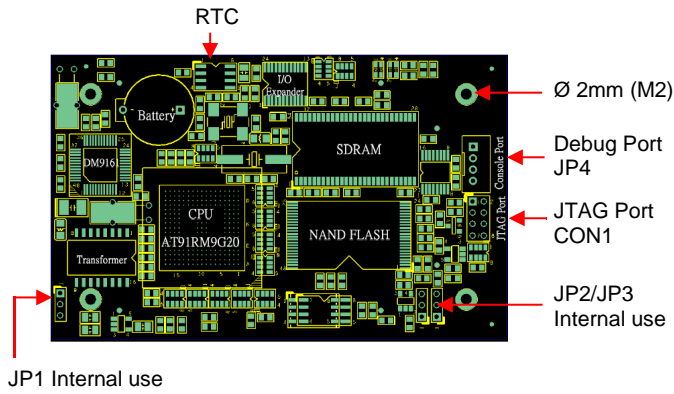
M-502 is an ARM9-based Linux ready System on Module. The M-502 is equipped with an ATMEL AT9SAM9G20 SoC and features:

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

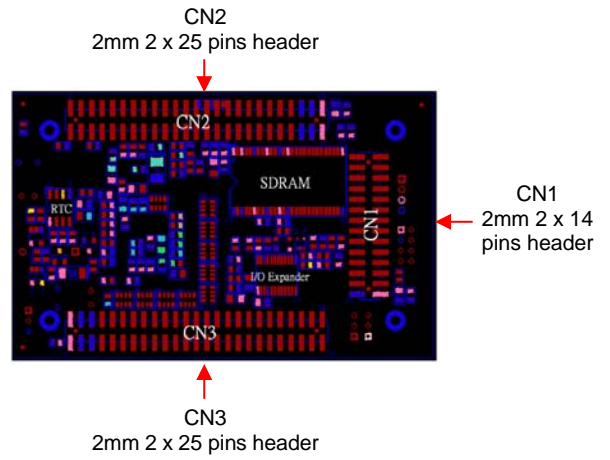
Linux 2.6.29 OS is pre-installed in the flash disk of M-502 and many powerful utility programs are also included. M-502 is ready to drop in your design to save your time in software porting and hardware debug.

2. Layout

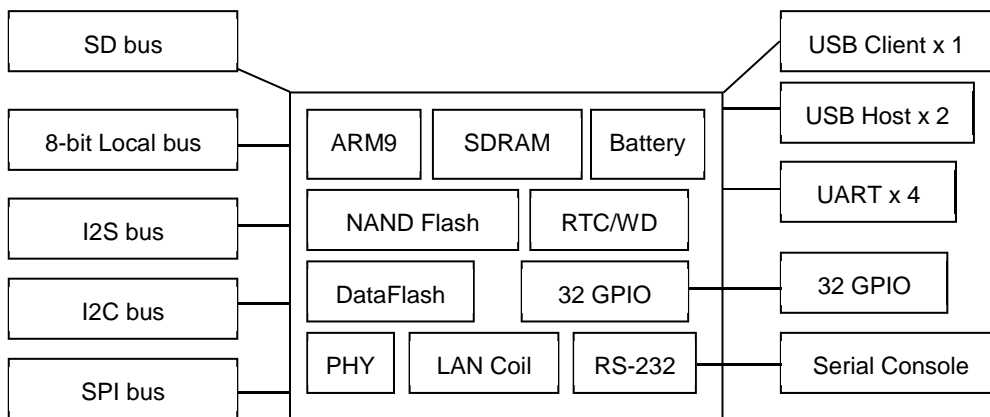
Front View



Rear View



Function Block Diagram



3. Hardware Specifications

CPU / Memory

- SoC: ATMEL AT91SAM9G20
- CPU: ARM926EJ-S ARM Thumb Processor with Memory Management Unit (MMU)
- Clock: 400MHz
- SDRAM: 64MB
- Flash: 128MB NAND Flash and 2MB DataFlash

Network

- Ethernet: 10/100Mbps with MAC/PHY and Transformer
- PHY: DAVCOM DM9161
- Transformer: 1.5 KV isolation
- Signal: **ETX0+**, **ETX0-**, **ERX0+**, **ERX-**

USB Port

- Host: USB 2.0 full speed (12Mbps) Host x2
- Signal: **UDataA+**, **UDataA-**, **UDataB+**, **UDataB-**
- 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
- RS-485 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)

I2C Bus (Inter-IC 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

SPI (Serial Peripheral Interface)

- 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, MCDA0, MCDA1, MCDA2, MCDA3***

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

4. Software Specifications

4.1 General

- OS: Linux 2.6.29
- Boot Loader: U-Boot 1.1.2
- File System: JFFS2, EXT2/EXT3, VFAT/FAT, NFS

4.2 Protocol Stacks

- IPV4, ICMP, ARP, DHCP, NTP, TCP, UDP, FTP, Telnet, HTTP, PPP, PPPoE, CHAP, PAP, SMTP, SNMP V1/V3, SSL, SSH 1/2

4.3 Utilities

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

4.4 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

4.5 Toolchain for Windows / Linux

- GCC: C/C++ PC cross compiler
- GLIBC: POSIX Library

4.6 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

4.7 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

4.8 I/O Devices Control

M-502 uses standard I/O device control to access following devices:

- Ethernet: eth0
- Serial Ports: ttyS1, ttyS2, ttyS3, ttyS4
- Serial Console Port: ttyS0
- Real time clock: rtc0
- USB Flash Disk: sda, sda1, sdb, sdb1
- SD memory Card: mmc0
- USB WLAN dongle: wlan0
- USB Serial Cable: ttyUSB0, ttyUSB1
- SPI bus: spi0, spi1

Note

- 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.

4.9 File System

M-502 uses ubi file system for the built-in flash memory disk. The files system is stored at NAND flash memory.

4.10 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
```

4.11 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***.

4.12 Welcome Message

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

4.13 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-504 is found, you can click the Telnet Console to configure the Matrix-504.

Note

- Please refer to the software guide for the software operation.

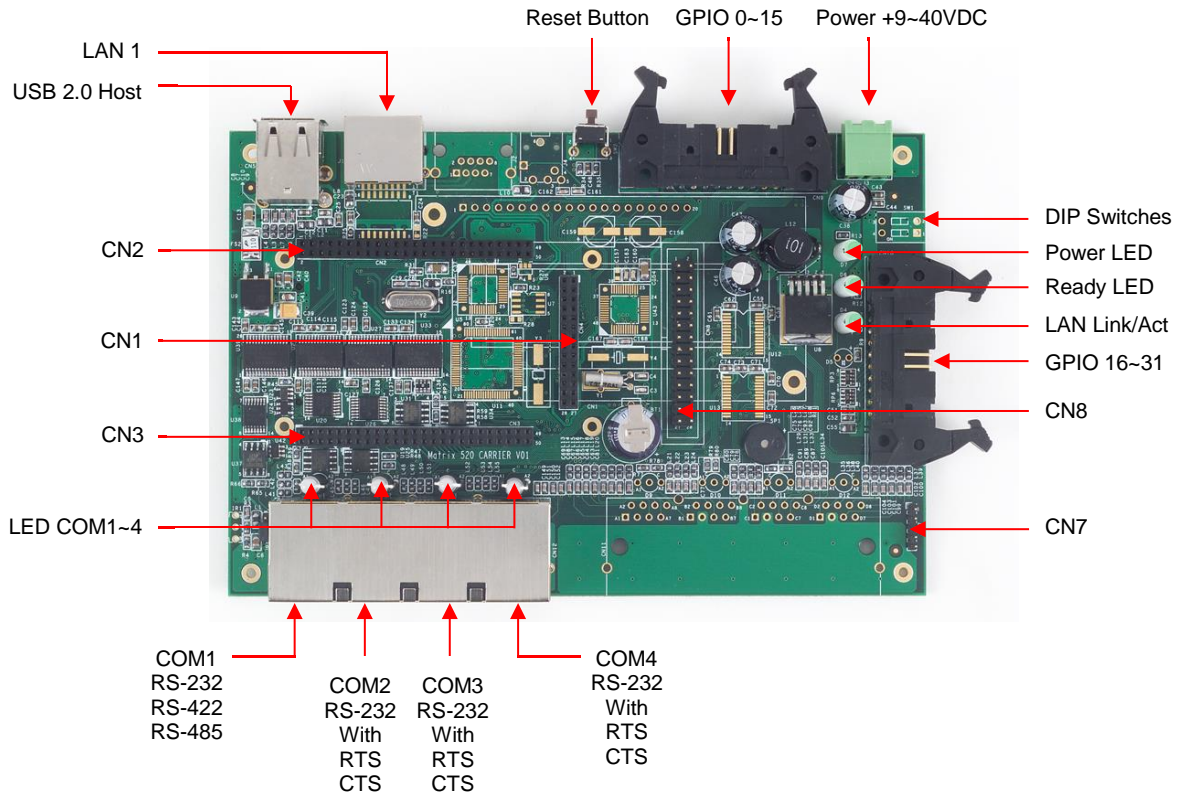
5. Pin Assignment and Definition

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	NRD	(Read Enable)	
(USB-Device-)	DDM	DDM	19	CS5	NCS5	(Chip Select)
(Chip Select)	NCS6	CS6	21	CS0	NCS0	(Chip Select)
(USB-Device+)	DDP	DDP	23		IRQ0	(Interrupt 0)
(Console TXD)	DTXD_232		25		DRXD-232	(Console RXD)
	VCC3		27		GND	
CN1						

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	DIP_SW PB12 (DIP_SW)
(DIP_SW)	PB13	DIP_SW	13	14	PIO16 I/O_16 (GPIO)
(GPIO)	I/O_17	PIO17	15	16	PIO18 PC1/PCK0 (GPIO)
(GPIO)	I/O_19	PIO19	17	18	PIO20 I/O_20 (GPIO)
(GPIO)	I/O_21	PIO21	19	20	PIO22 I/O_22 (GPIO)
(GPIO)	I/O_23	PIO23	21	22	PIO24 I/O_24 (GPIO)
(GPIO)	I/O_25	PIO25	23	24	PIO26 I/O_26 (GPIO)
(GPIO)	I/O_27	PIO27	25	26	PIO28 I/O_28 (GPIO)
(USB B+)	HDPB	UdataB+	27	28	UdataB- HDMB (USB B-)
(USB A-)	HDMA	UdataA-	29	30	UdataA+ HDP A (USB A+)
(GPIO)	I/O_29	PIO29	31	32	PIO30 I/O_30 (GPIO)
(GPIO)	I/O_31	PIO31	33	34	VCC3 PWROK (System Reset)
(Reset Btn)	BTNRST#		35	36	UDIO (USB-Device I/O)
(Buzzer)	PA26	BUZR	37	38	PC6 (System Ready LED)
(I2S transmitter)	TF0	TWS	39	40	TSCK TK2 (I2S transmitter)
(I2S transmitter)	TD0	TSD	41	42	RSD RD2 (I2S receiver)
(I2S receiver)	RK0	RSCK	43	44	RWS RF2 (I2S receiver)
	GND		45	46	GND
	GND		47	48	GND
	VCC3		49	50	VCC3
CN2					

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	14	SPCK	(SPI)
(SPI)	NPCS0	15	16	NPCS3	(SPI)
(SD)	MCCK	17	18	MCCDA	(SD)
(SD)	MCDA0	19	20	MCDA1	(SD)
(SD)	MCDA2	21	22	MCDA3	(SD)
(Card Detect)	SDCD	23	24	SDWP	(SD Write Protect)
(I2C)	TWD	25	26	TWCK	(I2C)
(GPIO)	I/O_1	PIO1	27	PIO3	I/O_3 (GPIO)
(GPIO)	I/O_4	PIO4	29	PIO5	I/O_5 (GPIO)
(GPIO)	I/O_6	PIO6	31	PIO7	I/O_7 (GPIO)
(GPIO)	I/O_8	PIO8	33	PIO9	I/O_9 (GPIO)
(GPIO)	I/O_10	PIO10	35	PIO11	I/O_11 (GPIO)
(GPIO)	I/O_12	PIO12	37	PIO13	I/O_13 (GPIO)
(GPIO)	I/O_14	PIO14	39	PIO15	PC15 (GPIO)
(GPIO)	I/O_0	PIO0	41	PIO2	I/O_2 (GPIO)
(COM1)	TXD1	43	44	RXD1	(COM1)
(COM1)	CTS1	45	46	RTS1	(COM1)
(COM2)	DTR2	47	48	TXD2	(COM2)
(COM2)	RXD2	49	50	DCD2	(COM2)
CN3					

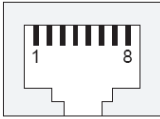
6. M-502 Evaluation Board Layout



7. Pin Assignment of Connectors

7.1 LAN1

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



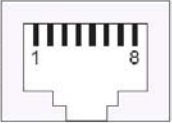
7.2 GPIO Port 0~15 and GPIO Port 16

+3.3V	20	19	+5V
GND	18	17	GND
DIO15	16	15	DIO14
DIO13	14	13	DIO12
DIO11	12	11	DIO10
DIO9	10	9	DIO8
DIO7	8	7	DIO6
DIO5	6	5	DIO4
DIO3	4	3	DIO2
DIO1	2	1	DIO0

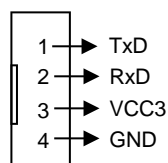
+3.3V	20	19	+5V
GND	18	17	GND
DIO31	16	15	DIO30
DIO29	14	13	DIO28
DIO27	12	11	DIO26
DIO25	10	9	DIO24
DIO23	8	7	DIO22
DIO21	6	5	DIO20
DIO19	4	3	DIO18
DIO17	2	1	DIO16

7.3 COM Port

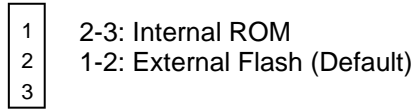
Pin	RS-232	RS-422	RS-485
1		---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6		RXD-	---
7	CTS	---	---
8		---	---



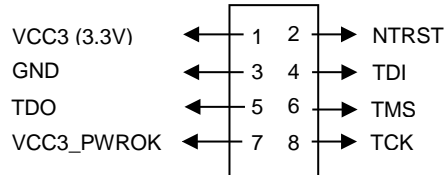
7.4 JP4 Serial Console Port



7.5 JP2 of M-502 Boot Mode Selection Jumper

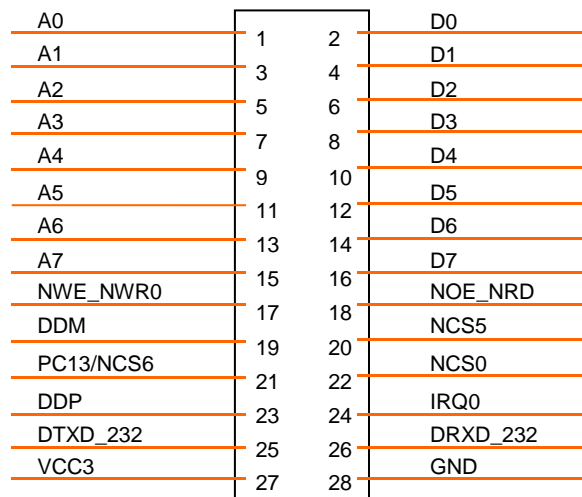


7.6 CON1 JTAG Connector



7.7 CN8 Local Bus Connector

- 1x14 Pin Header Pitch 2.54mm
- CN8 directly connect to CN1 of M-502



7.8 CN7 (SPI) Pin Assignment

