M-501 Industrial ARM9 Linux-based System-on-Module

- ATME 180MHz AT91RM9200 CPU w/ MMU
- Linux kernel 2.6.14 with file system
- 64MB SDRAM/16MB NOR Flash
- 1 x 10/100Mbps Ethernet
- On-board Ethernet PHY/transformer
- 2 x USB 2.0 Hosts supporting full speed of 12Mbps
- 1 x SD (secure digital) interface
- 4 x 921.6Kbps UARTs w/ hardware flow control
- I2C Interface
- I2S Interface, one transmitter and one receiver
- SPI w/ 2 x chip select signals
- External local bus (A0-A7, D0-D7, RD, WR), with 4x chip select signals

Overview

M-501 is a credit card size ARM9 Linux-based System on Module (SoM). M-501 is powered by 180MHZ AT91RM9200 ARM Thumb Processor with memory management unit, and equipped with 64MB SDRAM, and 16MB NOR Flash. M-501 is also pre-installed with Linux 2.6.14 OS, busybox utility collection, wget, and various hardware device drivers. M-501 comes with one 10/100Mbps Ethernet, two USB 2.0 hosts, four UARTs with hardware flow control, and 32 programmable digital I/Os. In addition, Secure Data Card (SD) interface, Serial Peripheral Interface (SPI), Inter-IC (I2C) bus, Inter-IC Sound (I2S) bus, and external local bus are included. M-501 is a reliable SoM to be used in various embedded systems. It is ideal for all kinds of industrial applications, including intelligent transportation system (ITS), building automation, energy-saving system, and scenario control systems.

Front View of M-501

Back View of M-501

- 32 x GPIOs, CMOS/3.3V compatible
- Compact size, 50 x 80mm only
- Ultra low power consumption of less than 2.5W
- GNU C/C++ tool chain is included

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Hardware Specifications

CPU/Memory
CPU: ATMEG 180MHz AT91RM9200 w/ MMU
SDRAM: 64MB
NOR Flash: 16MB

Network Interface
Type: Ethernet, 10/100Mbps
PHY: DAVICOM DM9161
Protection: 1.5KV magnetic isolation

UART
Port 0: TXD0, RXD0, RTS0, CTS0, GND
Port 1: TXD1, RXD1, RTS1, CTS1, DCD1, DTR1, DSR1, GND
Port 2: TXD2, RXD2, RTS2, CTS2, GND
Port 3: TXD3, RXD3, RTS3, CTS3, GND
Signal Level: CMOS/3.3V compatible

Common UART Parameters
Baud Rate: up to 921.6Kbps
Parity: None, Even, Odd, Mark, Space
Data Bits: 5, 6, 7, 8
Stop Bits: 1, 1.5, 2
Flow Control: RTS/CTS, XON/XOFF, None

UART Advanced Feature (when used as RS-485)
Supports 9-bit Multi-drop mode
Supports hardware auto direction control

USB Ports
Hosts: Two, USB 2.0 compliant
Host Signals: UdataA+, UdataA-, UdataB+, UdataB-

I2C (Inter-IC Bus)
Signals: TWD, TWDK
Supported Devices: (driver has been built-in)

I2S (Inter-IC Sound)
Transmitter Signals: TSCK, TWS, TSD
Receiver Signals: RSCK, RWS, RSD

SPI (Serial Peripheral Interface)
Signals: MISO, MOSI, SPCK, CS1, CS2

SD (Secure Digital Card Interface)
Signals: MCCDA, MCCK, MCDA0-MCDA3
Compatible with SD memory card Specification 1.0

Watchdog Timer
CPU built-in internal watchdog timer, used by Linux kernel

General-Purpose IOs (GPIO)
32 x GPIOs can be programmed as digital input or output
Supports interrupt function when GPIOs are set as digital input
Signal Level: CMOS/3.3V compatible

Pre-defined Pins
Reset Button (CN2, pin#35), input
Buzzer (CN2, pin#37), output
2-pin DIP SW (CN2, pin#12,#13), input
System ready LED (CN2, pin#38), output
LAN activity LED (CN3, pin#11), output

Undefined Digital IO Pins (reserved)
CN1: pin#23, #24, #25, #26
CN3: pin#23, #24

Debug Ports
JTAG Port: for low level debug
Console Port: Tx/Rx serial console (share RTS3, CTS3)

Local Bus
Data Bus: 8-bit (D0-D7)
Address Bus: 8-bit (A0-A7)
Chip Select: x 4 (CS3, CS4, CS5, CS6)
Control Bus: RD, WR
Signal Level: CMOS/3.3V Compatible

Power Consumption
Input range: 3.0 to 3.6VDC (3.3V nominal)
Consumption: 2W

Power Consumption
Board Dimension: 50 x 80mm
2.0mm pitch Connectors
CN1: 28 pins; CN2: 50 pins; CN3: 50 pins
Mounting Holes: x 4, 2.0mm (M2) in diameter
Software Specifications

General
OS: Linux, Kernel 2.6.14
Boot Loader: U-Boot 1.1.2
File Systems: JFFS2, ETX2, VFAT/FAT, NFS

Pre-installed Utilities
bash, busybox, wget, boa, iptable, ppp, ssh, wireless_tools, Artila utility. (More utilities can be found in the product CD.)

Daemons Started by Default
ssh (secured shell)
syslog/klogd (system and kernel log)
telnet server (disable root with/etc/security)
ftp server (vsftpd)
Web server ( lighttpd )
amgrd (Artila broadcast search daemon)

Tool Chain for Linux
GCC: C/C++ PC cross compiler
GLIBC: POSIX Library

Standard Device Drivers
SD/MMC, UART, Ethernet, GPIO, Buzzer
Real Time Clock: supports Ricoh RS5C372
EEPROM: supports ATMEG AT24C16 and its compatibles

Pre-load USB Host Drivers (customizable)
Flash thumb disk
IEEE-802.11b/g WiFi adapter (Ralink rt73usb)
10/100Mbps Fast Ethernet adapter (RT8150)
RS-232 adapter (prolific PL-2303)
ADSL modem
ISDN modem (CDC/ACM compatible)
**Ordering Information**

M-501  
AT91RM9200 + Linux 2.6.14 System on Module with 64MB SDRAM, 16MB NOR Flash

M-501-16 Starter Kit  
Includes one M-501 SoM and one carrier board with power circuitry, 3 x RS-232 ports, 1 x RS-232/422/485 port, 1 x Ethernet port, 2 x USB hosts, 1 x SD socket (at back side), 2 x GPIO connectors, Real Time Clock, EEPROM, and local bus connector

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**PIN Assignments**

### CN1

<table>
<thead>
<tr>
<th>No.</th>
<th>Pin Assignment</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A0</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>2</td>
<td>A1</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>3</td>
<td>A2</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>4</td>
<td>A3</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>5</td>
<td>A4</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>6</td>
<td>A5</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>7</td>
<td>A6</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>8</td>
<td>A7</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>9</td>
<td>WE</td>
<td>(Write Enable)</td>
</tr>
<tr>
<td>10</td>
<td>CS2</td>
<td>(Chip Select)</td>
</tr>
<tr>
<td>11</td>
<td>CS3</td>
<td>(Chip Select)</td>
</tr>
<tr>
<td>12</td>
<td>CS4</td>
<td>(Chip Select)</td>
</tr>
<tr>
<td>13</td>
<td>CS5</td>
<td>(Chip Select)</td>
</tr>
<tr>
<td>14</td>
<td>RD</td>
<td>(Read Enable)</td>
</tr>
<tr>
<td>15</td>
<td>DS0</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>16</td>
<td>DS1</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>17</td>
<td>DS2</td>
<td>(Data Bus)</td>
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<tr>
<td>18</td>
<td>DS3</td>
<td>(Data Bus)</td>
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<tr>
<td>19</td>
<td>TXD</td>
<td>(Data Bus)</td>
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<tr>
<td>20</td>
<td>RXD</td>
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<tr>
<td>21</td>
<td>RTS</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>22</td>
<td>CTS</td>
<td>(Data Bus)</td>
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<tr>
<td>23</td>
<td>DCD</td>
<td>(Data Bus)</td>
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### CN2

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<th>Function</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CS2</td>
<td>(Chip Select)</td>
</tr>
<tr>
<td>2</td>
<td>CS3</td>
<td>(Chip Select)</td>
</tr>
<tr>
<td>3</td>
<td>CS4</td>
<td>(Chip Select)</td>
</tr>
<tr>
<td>4</td>
<td>CS5</td>
<td>(Chip Select)</td>
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<tr>
<td>5</td>
<td>DSR2</td>
<td>(Data Bus)</td>
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<tr>
<td>6</td>
<td>DSR3</td>
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<td>DSR4</td>
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<td>8</td>
<td>DSR5</td>
<td>(Data Bus)</td>
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<td>9</td>
<td>DTR</td>
<td>(Data Bus)</td>
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<td>10</td>
<td>RTS1</td>
<td>(Data Bus)</td>
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<tr>
<td>11</td>
<td>CTS1</td>
<td>(Data Bus)</td>
</tr>
<tr>
<td>12</td>
<td>RTS2</td>
<td>(Data Bus)</td>
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<tr>
<td>13</td>
<td>CTS2</td>
<td>(Data Bus)</td>
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### CN3

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<th>Pin Assignment</th>
<th>Function</th>
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</thead>
<tbody>
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<td>VCC3</td>
<td>(Power)</td>
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<tr>
<td>2</td>
<td>GND</td>
<td>(Ground)</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>(Ground)</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>(Ground)</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>(Ground)</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>(Ground)</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>(Ground)</td>
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<tr>
<td>8</td>
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<td>(Ground)</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>(Ground)</td>
</tr>
<tr>
<td>10</td>
<td>GND</td>
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<td>GND</td>
<td>(Ground)</td>
</tr>
<tr>
<td>12</td>
<td>GND</td>
<td>(Ground)</td>
</tr>
</tbody>
</table>

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**Module Dimensions**

- Width: 44.5 mm
- Height: 32.5 mm
- Thickness: 5 mm
- Weight: 50 grams

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