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

- ATMEL 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-I C 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

- 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

Back View of M-501

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Hardware Specifications

CPU/Memory
CPU: ATMEL 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

**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 ATMEL 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)
**PIN Assignments**

- **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) WE 17 18 RD (Read Enable)
  - (Chip Select) CS1 19 20 CS1 (Chip Select)
  - (Chip Select) CS2 21 22 CS2 (Chip Select)
  - N/A 23 24 N/A
  - N/A 25 26 N/A
  - VCC3 27 28 GND

- **CN2**
  - (COM2) CTS2 1 2 DSR2 (COM2)
  - (COM2) RTS2 3 4 RD3 (COM3)
  - (COM3) TXD3 5 6 CTS3 (COM3)
  - (COM3) RTS3 7 8 TXD4 (COM4)
  - (COM4) RXD4 9 10 RTS4 (COM4)
  - (COM4) CTS4 11 12 SW10 (DIP SW)
  - (DIP SW) SW1 13 14 PIO16 (GPIO)
  - (GPIO) PIO17 15 16 PIO18CL (GPIO)
  - (GPIO) PIO18 17 18 PIO20 (GPIO)
  - (GPIO) PIO19 19 20 PIO22 (GPIO)
  - (GPIO) PIO20 21 22 PIO24 (GPIO)
  - (GPIO) PIO21 23 24 PIO26 (GPIO)
  - (GPIO) PIO22 25 26 PIO28 (GPIO)
  - (USB A) UdataA 27 28 UdataB (USB B)
  - (USB B+) UdataB 29 30 UdataA (USB A+)
  - (GPIO) PIO30 31 32 PIO30 (GPIO)
  - (GPIO) PIO31 33 34 PIO31 (GPIO)
  - (Reset Btn) RST1 35 36 RST2 (JTAG Device)
  - (Buzzer) BUZB 37 38 RDY LED (Ready LED)
  - (I2S) TWI 39 40 TSCK (I2S)
  - (I2S) TI2 41 42 RSD (I2S)
  - (I2S) PC0C 43 44 RAS (I2S)
  - GND 45 46 GND
  - GND 47 48 GND
  - VCC3 49 50 VCC3

- **CN3**
  - VCC3 1 2 VCC3
  - GND 3 4 GND
  - GND 5 6 GND
  - (LAN) RXD5 7 8 RXD+ (LAN)
  - (LAN) TXD5 9 10 TXD+ (LAN)
  - (LAN LED) ACT LED 11 12 MOSO (SPI)
  - (SPI) MOSI 13 14 SPCK (SPI)
  - (SPI) NPCSO 15 16 NPCSO3 (SPI)
  - (SD) MCC0 17 18 MCC0A (SD)
  - (SD) MCC1 19 20 MCC1A (SD)
  - (SD) MCC2 21 22 MCC2A (SD)
  - (SD) SDCD 23 24 SDMP (SD)
  - (I2C) TWI 25 26 TWI (I2C)
  - (GPIO) PIO1 27 28 PIO3 (GPIO)
  - (GPIO) PIO2 29 30 PIO5 (GPIO)
  - (GPIO) PIO3 31 32 PIO7 (GPIO)
  - (GPIO) PIO4 33 34 PIO9 (GPIO)
  - (GPIO) PIO5 35 36 PIO11 (GPIO)
  - (GPIO) PIO6 37 38 PIO13 (GPIO)
  - (GPIO) PIO7 39 40 PIO15/RO1 (GPIO)
  - (GPIO) PIO8 41 42 PIO2 (GPIO)
  - (GPIO) PIO9 43 44 RXD1 (CM1)
  - (GPIO) PIO10 45 46 RTS1 (CM1)
  - (GPIO) PIO11 47 48 TXD2 (CM2)
  - (GPIO) PIO12 49 50 DCD2 (CM2)

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**Ordering Information**

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