M-A5D35

Linux-Ready Cortex-A5
System on Module

Hardware Guide

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Artila

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Document Amendment History

Revision	Date	Remark
V 0.1	2017 Jan.	Initial
V 1.0	2017 Jul.	Hardware Guide

Table of Contents

1. Introduction

M-A5D35 is highly integrated, compact, low power consumption, the Linux-Ready ARM Cortex-A5 System-on-Module.
It provides an ideal building block that easily integrates with a wide range of target markets, such as industrial control, automation gateway and other applications.

Linux 4.9.X OS is pre-installed in the flash disk of M-A5D35 and many powerful utility programs are also included. M-A5D35 is ready to drop in your design to save your time in software porting and hardware debug.

1.1 Features

- ATSAMA5D35 ARM Thumb Processor with 536MHz, Memory Management Unit
- 32-KByte Data Cache and 32-KByte Instruction Cache
- 512MB SDRAM LPDDR2, 8GB eMMC Flash, 8MB DataFlash
- Dual Ethernet interface:
  - One 10/100Mbps Ethernet with MAC/PHY and transformer,
  - One Gigabit Ethernet with MAC/PHY and transformer
- Two USB 2.0 Hi-speed (480Mbps) Host Ports
- Multimedia Card Interface for SDHC memory card
- Four UARTs with hardware and software flow control
- On board Real Time Clock with Lithium battery
- I^2C bus
- I^2S bus
- 21 Programmable Digital I/O Port
- Serial Peripheral Interface (SPI) Ports
- Linux 4.4.X OS

1.2 Specifications (Hardware)

- **CPU / Memory**
  - CPU: ATMEL ATSAMA5D35
  - ARM Cortex-A5 Thumb Processor with Memory Management Unit (MMU)
  - Clock: 536MHz
  - SDRAM: 512MB, LPDDR2
  - Flash: 8G eMMC Flash and 8MB DataFlash

- **Network**
  - Ethernet: 10/100Mbps/Gigabit with MAC/PHY and Transformer
  - PHY: Micrel KSZ8081RNAIA(10/100Mbps)
  - LAN port Signal: ETH1_TXO0+, ETH1_TXO0-, ETH1_RXI0+, ETH1_RXI0-
  - PHY: Micrel KSZ9031RNXCA (Gigabit)
  - GLAN port Signal: GETH0_TX1+,GETH0_TX1-, GETH0_RX1+, GETH0_RX1-, GETH0_TX2+,GETH0_TX2-, GETH0_RX2+, GETH0_RX2-
  - Transformer: 1.5 KV isolation
- **USB Port**
  - Host: USB 2.0 Hi speed (480Mbps) Host x2
  - Signal: USB Host_1 Data+, USB Host_2 Data-, USB Host_2 Data+, USB Host_2 Data-
  - 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 (PD16,PB27,PE24,PE17)
  - Signal Level: CMOS/3.3V compatible
  - COM1: TXD, RXD, RTS (Software configurable RS-232/485 mode)
  - COM2: TXD, RXD, RTS, CTS (Software configurable RS-232/485 mode)
  - COM3: TXD, RXD, RTS, CTS (Software configurable RS-232/485 mode)
  - COM4: TXD, RXD, RTS, CTS (Software configurable RS-232/485 mode)
- **Programmable DIO**
  - 63 General Purpose I/O can be programmable as digital input or output
  - Signal Level: CMOS/TTL Compatible
  - Digital Input:
    - Low level: -0.3V min / +0.8V max
    - High level: +2.0V min / +3.6V max
  - Digital Output:
    - Low level: +0.4V max @ 8mA
    - High level: +2.9V min @ 8mA
  - Signal: GP*IO – PA Number, PB Number, PC Number, PD Number, PE Number*

- **SPI (Serial Peripheral Interface)**
  - Two chip Selects with external decoder
  - Three wires signals: MISO, MOSI and CLK clock
  - Signal: *MISO, MOSI, CLK, CS0, CS1, CS2, CS3*
  - Supported Device: ATMEL DataFlash
- **Predefine Pins**
  - Reset Button (CN1, pin#35, BTN*RST*#), input
  - Buzzer (CN1, pin#29, PD6/TIOB0), output
  - System Ready LED (CN1, pin#19, PD5/TIOA0), output
  - LAN Activity LED (CN1, pin#14, GLAN ACTLED1#, CN1 Pin#12 ELAN ACTLED2#), output
- **Debug Port**
  - Signal: Debug_TX, Debug_RX
  - Connector: JP1
- **Power**
  - Input: 4.75 to 5.25VDC (5V nominal)
  - Consumption: 0.75W

1.3 Specifications (Software)

- **Operation System**
  - Linux kernel 4.9.x
  - Supports bootup from eMMC or SD card
  - Boot Loader: Barebox
  - File System: EXT4
    - M-A5D35 uses ETX4 file system for the built-in flash memory disk.
    - The files system is stored at NAND flash memory.
- **Software Development**
  - Toolchain: gcc 6.2.0xx + glibc 2.24xx
  - Supports in-place C/C++ code compilation
- **Package Management**
  - Package repository: Artila self-maintained repository
  - Command: Using standard apt-get command
- **Popular Packages**
  - Web server: Apache/Nginx/Lighttpd
  - Database: MySQL/SQLite3/PostgreSQL
  - Script Language: PHP/Python/Perl/NodeJS
  - Text editor: vim/nano/sed
  - Administration: Webmin

- **Protocol Stacks**
  - IPV4, ICMP, ARP, DHCP, NTP, TCP, UDP, FTP, HTTP, PPP, PPPoE, CHAP, PAP, SMTP, SNMP V1/V3, SSL, SSH 1/2
- **Utilities**
  - Bash: Shell Command
  - 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
  - inetd: TCP server program
  - ftpd: FTP server program
  - nginx: Web server program
  - sshd: secured shell server
  - iptables: Firewall service manager
- **Standard Device Drivers**
  - ttyS0: serial console port (M-A5D35 debug port)
  - ttyS1~ttyS4: serial ports (M-A5D35 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
- **I/O devices Control**

  M-A5D35 uses standard I/O device control to access following devices:
  - Ethernet: eth0, eth1
  - 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

- **Default Setting**
  - IP Default setting:
    - eth0: DHCP
    - eth1: 192.168.2.127 (Netmask: 255.255.255.0)
  - ssh Login: root
  - Password: root
  - Terminal type: VT100

1.4 Packing List

- M-A5D35: Linux-ready Cortex-A5 536MHz SoM (System on Module) with 512MB SDRAM, 8GB eMMC Flash

1.5 Optional

Accessory

- DK-35A (36-DK35A-000): DIN RAIL Mounting Kit
- PWR-12V-1A (31-62100-000): 110~240VAC to 12VDC 1A Power Adaptor

Starter Kit

- CB-Matrix-700 (M-A5D35 included), Linux
- 91-PHDF9-050: Console Cable (4Pin header to DB9 Female, 50cm)

2. SAMA5D35: ARM Cortex-A5 MPU

SAMA5D3 series is a high-performance, power-efficient embedded MPU based on the ARM® Cortex®-A5 processor, achieving 536 MHz with power consumption levels below 0.5 mW in low-power mode. The device features a floating point unit for high-precision computing and accelerated data processing, and a high data bandwidth architecture. It integrates advanced user interface and connectivity peripherals and security features. Detail information, please refer to http://www.microchip.com/wwwproducts/en/ATSAMA5D35

2.1 SAMA5D35 Features

Core

- ARM Cortex-A5 Processor with ARMv7-A Thumb-2 Instruction Set
- CPU Frequency up to 536 MHz
- 32 Kbyte Data Cache, 32 Kbyte Instruction Cache, Virtual Memory System Architecture (VMSA)
- Fully Integrated MMU and Floating Point Unit (VFPv4)

Memories

- One 160 Kbyte Internal ROM Single-cycle Access at System Speed, Embedded Boot Loader: Boot on 8-bit
- NAND Flash, SDCard, eMMC, serial DataFlash, selectable Order
- One 128 Kbyte Internal SRAM, Single-cycle Access at System Speed
- High Bandwidth 32-bit Multi-port Dynamic RAM Controller supporting 512 Mbyte 8 bank 32-bit or 2x16-bit
- SDRAM devices
- Independent Static Memory Controller with datapath scrambling and SLC/MLC NAND Support with up to 24-bit
- Error Correction Code (PMECC)

System running up to 166 MHz

- Reset Controller, Shutdown Controller, Periodic Interval Timer, Watchdog Timer and Real-time Clock
- Boot Mode Select Option, Remap Command
- Internal Low-power 32 kHz RC Oscillator and Fast 12 MHz RC Oscillator
- Selectable 32768 Hz Low-power Oscillator and 12 MHz Oscillator
- One 400 to 1000 MHz PLL for the System and one PLL at 480 MHz optimized for USB High Speed
- 39 DMA Channels including two 8-channel 64-bit Central DMA Controllers

- 64-bit Advanced Interrupt Controller
- Three Programmable External Clock Signals
- Programmable Fuse Box with 256 fuse bits (of which 192 are available for users)

Low Power Management

- Shutdown Controller
- Battery Backup Registers
- Clock Generator and Power Management Controller
- Very Slow Clock Operating Mode, Software Programmable Power Optimization Capabilities

Peripherals

- LCD TFT Controller with Overlay, Alpha-blending, Rotation, Scaling and Color Space Conversion
- ITU-R BT. 601/656 Image Sensor Interface
- Three HS/FS/LS USB Ports with On-Chip Transceivers
  - One Device Controller
  - One Host Controller with Integrated Root Hub (3 Downstream Ports)
- One 10/100/1000 Mbps Gigabit Ethernet Media Access Controller (GMAC) with IEEE1588 support
- One 10/100 Mbps Ethernet Media Access Controller (EMAC)
- Two CAN Controllers with 8 Mailboxes, fully compliant with CAN 2.0 Part A and 2.0 Part B
- Softmodem Interface
- Three High Speed Memory Card Hosts (eMMC 4.3 and SD 2.0)
- Two Master/Slave Serial Peripheral Interfaces
- Two Synchronous Serial Controllers
- Three Two-wire Interface up to 400 Kbit/s supporting I2C Protocol and SMBUS
- Four USARTs (ISO7816, IrDA , RS-485, SPI, Manchester and Modem Modes)
- Two UARTs
- One DBGU
- Two 3-channel 32-bit Timer/Counters
- One 4-channel 16-bit PWM Controller
- One 12-channel 12-bit Analog-to-Digital Converter with Resistive Touchscreen function

Safety

- Power-on Reset Cells
- Independent Watchdog
- Main Crystal Clock Failure Detection
- Register Write Protection
- SHA: Supports Secure Hash Algorithm (SHA1, SHA224, SHA256, SHA384, SHA512)
- Memory Management Unit

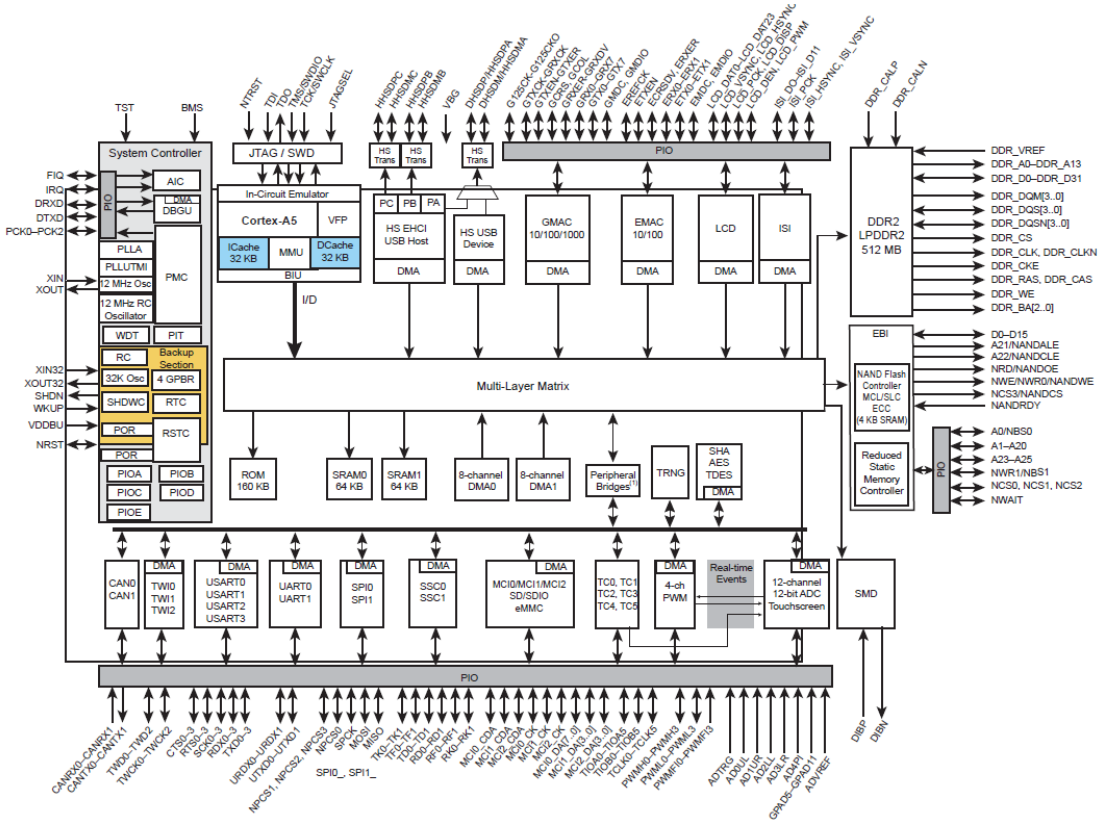
Security

- TRNG: True Random Number Generator
- Encryption Engine
  - AES: 256-bit, 192-bit, 128-bit Key Algorithm, Compliant with FIPS PUB 197 Specifications
  - DES: Two-key or Three-key Algorithms, Compliant with FIPS PUB 46-3 Specifications
- Atmel Boot Solution

I/O

- Five 32-bit Parallel Input/Output Controllers
- 160 I/Os
- Input Change Interrupt Capability on Each I/O Line, Selectable Schmitt Trigger Inpu
- Individually Programmable Open-drain, Pull-up and Pull-down Resistor, Synchronous Output, Filtering
- Slew Rate Control on High Speed I/Os
- Impedance Control on DDR I/Os

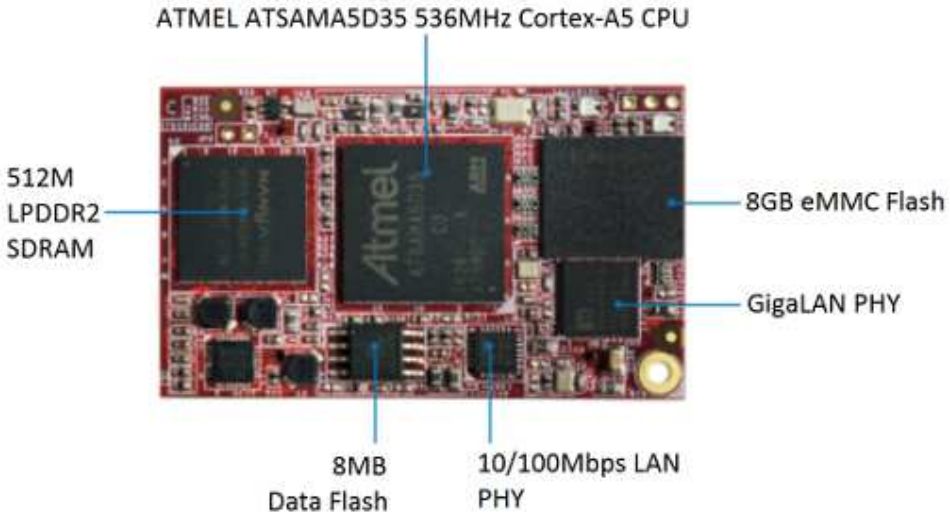
2.2 SAMA5D35 Block Diagram



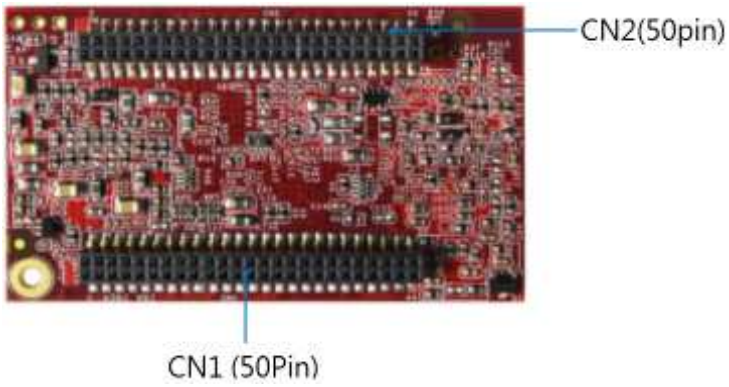
3. Layout

3.1 Outlook

Top View

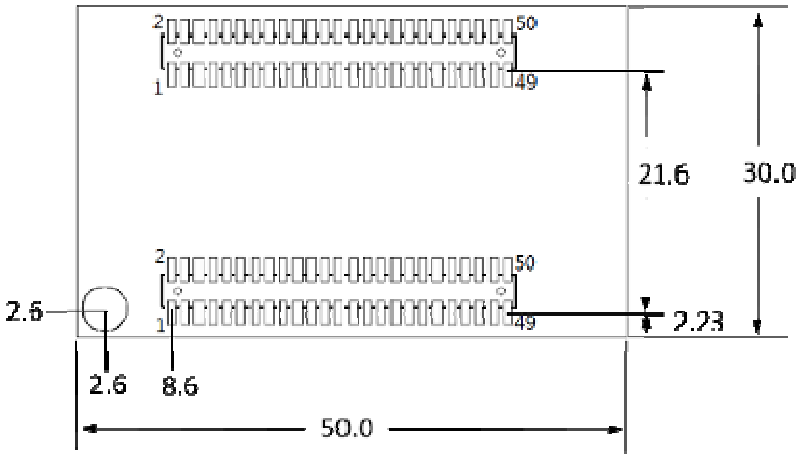


Bottom View



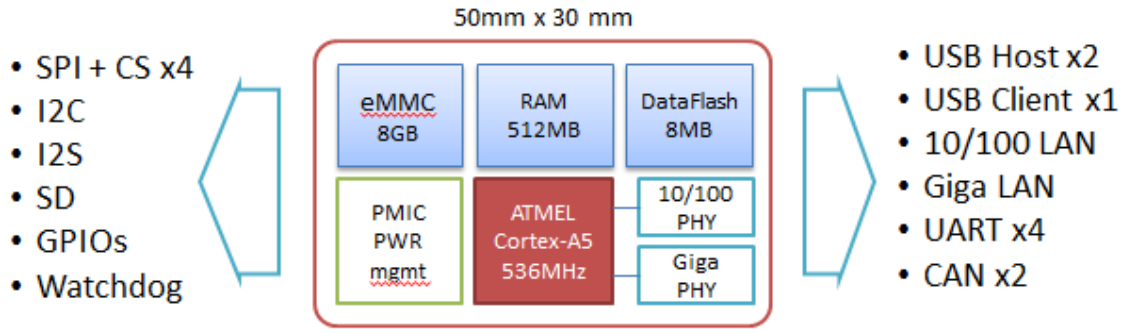
3.2 Dimensions

(unit:mm)



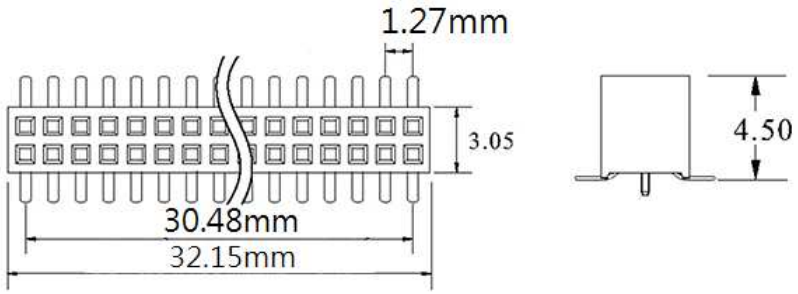
4. Pin Assignment and Definitions

4.1 Block Diagram



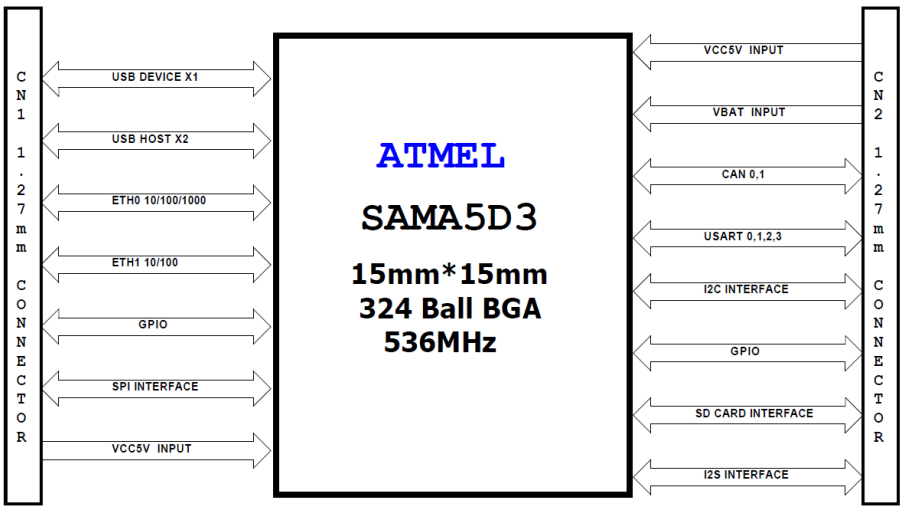
4.2 Connector Information

- 50pin dual raw female header
- Pitch: 1.27mm
- Current Rating: 1Amp



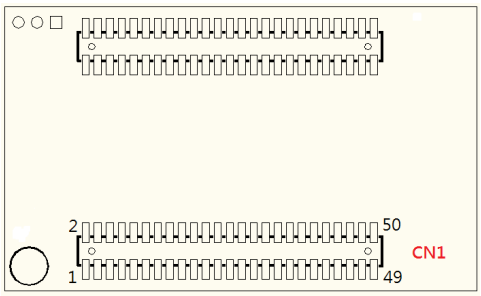
4.3 Connector and PIN definition

The M-A5D35 exposes a pair of 50pin connector, here is the connector information and pin definition.



4.3.1 Connector (CN1)

CN1 includes signals: USB, GLAN, LAN, SPI, GPIO

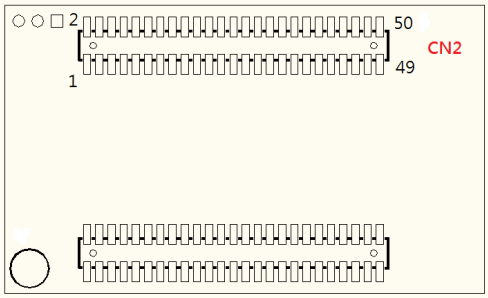


CN1

GLAN_RX2-	1	2	GLAN_RX2+
GLAN_TX2-	3	4	GLAN_TX2+
GLAN_RX1-	5	6	GLAN_RX1+
GLAN_TX1-	7	8	GLAN_TX1+
GLAN_GND	9	10	GLAN_GND
LAN_TX+	11	12	LAN_LED
LAN_TX-	13	14	GLAN_LED
LAN_RX+	15	16	Debug_TX
LAN_RX-	17	18	Debug RX
(PD5)	19	20	(PE31) / IRQ
USB Device Data-	21	22	USB Device Data+
USB Host_1 Data+	23	24	USB Host_2 Data+
USB Host_1 Data-	25	26	USB Host_2 Data-
(PD7)	27	28	PC22 or SPI_MISO
(PD6)	29	30	PC23 or SPI_MOSI
N/A	31	32	PC24 or SPI_CLK
N/A	33	34	PC25 or SPI_CS0
RST#1	35	36	PC26 or SPI_CS1
(PC29)	37	38	PC27 or SPI_CS2
(PC30)	39	40	PC28 or SPI_CS3
(PA30)	41	42	(PD19)
(PA31)	43	44	(PD20)
(PD30)	45	46	(PD21)
GND	47	48	GND
+5V	49	50	+5V

4.3.2 Connector (CN2)

CN2 includes signals: CAN, UART, VBAT, I2C, I2S, SD card



CN2

BAT_In	1	2	+5V
GND	3	4	GND
PD14 or CAN0_RXD	5	6	PB14 or CAN1_RXD
PD15 or CAN0_TXD	7	8	PB15 or CAN1_TXD
PD16 or COM1_RTS	9	10	PB26 or COM2_CTS
PD17 or COM1_RXD	11	12	PB27 or COM2_RTS
PD18 or COM1_TXD	13	14	PB28 or COM2_RXD
PE23 or COM3_CTS	15	16	PB29 or COM2_TXD
PE24 or COM3_RTS	17	18	PE16 or COM4_CTS
PE25 or COM3_RXD	19	20	PE17 or COM4_RTS
PE26 or COM3_TXD	21	22	PE18 or COM4_RXD
PA18 or I2C_Data	23	24	PE19 or COM4_TXD
PA19 or I2C_CLK	25	26	PC16 or I2S_TX_CLK
PD0 or SD_CMD	27	28	PC17 or I2S_TX_Sync
PD1 or SD_Data0	29	30	PC18 or I2S_TX_Data
PD2 or SD_Data1	31	32	PC19 or I2S_RX_CLK
PD3 or SD_Data2	33	34	PC20 or I2S_RX_Sync
PD4 or SD_Data3	35	36	PC21 or I2S_RX_Data
PD9 or SD_CLK	37	38	PD31 or Audio
PA27 or SD_CD	39	40	PA0
PA20	41	42	PA1
PA21	43	44	PA2
PA22	45	46	PA3
PA23	47	48	PA26
WDT Signal	49	50	NA

Note: pin7 also can be use as COM_CTS

5. Starter Kit

CB-Matrix-700 is an evaluation board for M-A5D35. It serves as a complete development kit for evaluation and application development purposes.

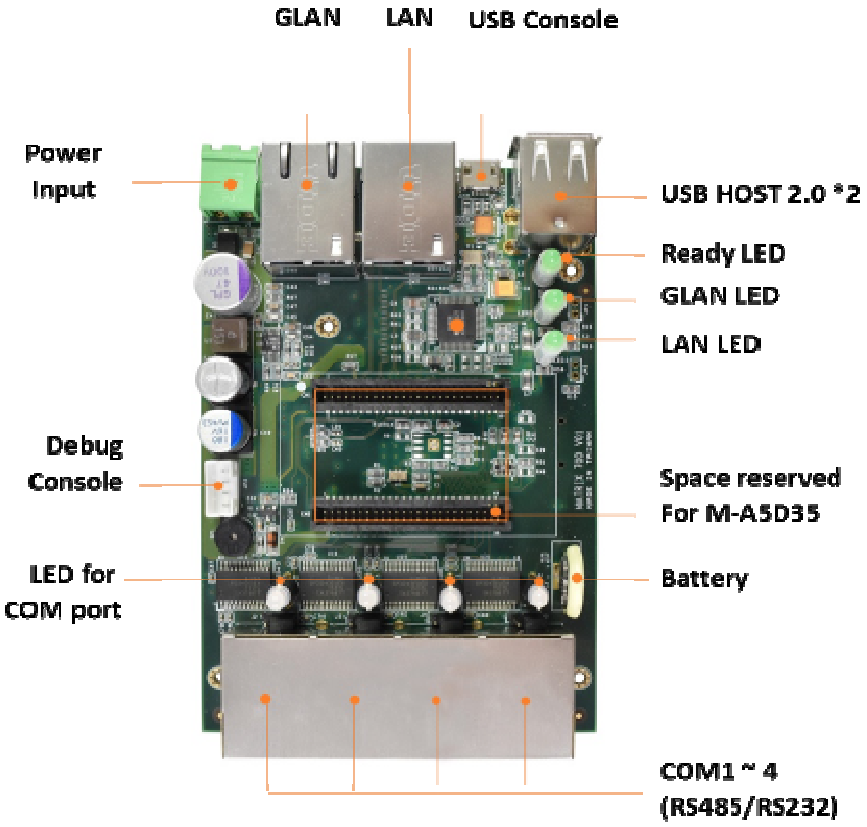
5.1 Features

- Support M-A5D35 System On Module via two 50pins connector
- One Gigabit Ethernet port (RJ45)
- One 10/100Mbps Ethernet port (RJ45)
- Two USB 2.0 high speed (480Mbps) Host ports
- Four software configurable RS-232/485 serial ports
- One USB console port
- One microSD socket reserved
- Watch-Dog Timer
- Real Time Clock
- Buzzer
- +9VDC to +48VDC power input
- Pre-installed the Linux kernel 4.4.X and file system
- GNU toolchain available on Artila's self-maintained repository
- Wall-mounting installation, Optional DIN-rail mounting kit

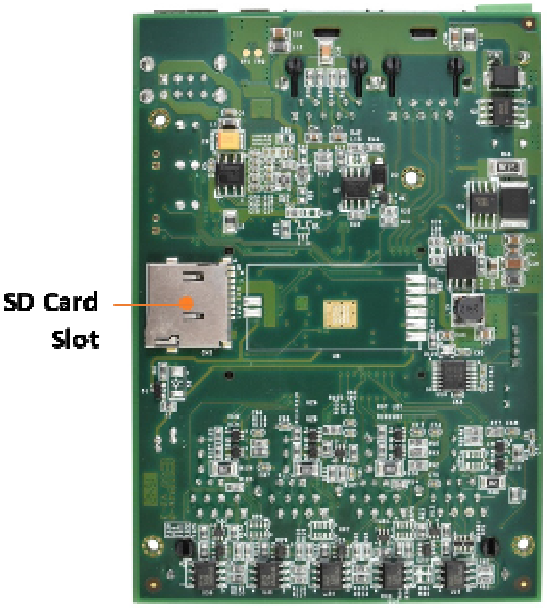
More comprehensive information can be found in the following documents and resources at http://www.artila.com/en/p_matrix.html

5.2 I/O ports

Top View



Bottom View



6. Initial Operation

This guide provides initial information about how to use the CB-Matrix-700 starter kit to start up M-A5D35 and initial operation with the supplied boot devices.

6.1 Using Default Linux file system

1. Power on M-A5D35, Console port automatically emulates an USB CDC/ACM compatible serial device. (Both USB console & Debug console port)
2. Plug the console cable from console port to PC:
   - USB console port (CN4), Micro-USB
   - Debug console port (JP3), 4pin header. Refer to attached console cable.
3. Download any PC terminal program. Artila suggests to use “Putty”.
4. The serial communication parameters are: 115200, N81, VT100.
5. The identifier name on PC,
   - On Linux system, the serial port name looks like ttyACM0, ttyACM1, etc.
   - On OSX system, the serial port name looks like tty.usbmodem1421, tty.usbmodem1422, etc.
   - On Windows system, the serial port name looks like COM3, COM4, etc.

6.2 Install Software Package

M-A5D35/CB-Matrix-700 supports standard **apt** (Advanced Package Tool) package management utility for installation, upgrade and remove software packages.
Artila supports apt configuration file also. You may have software support at http://www.artila.com/download/A5D35/Linux/