

Matrix-713

Linux-Ready Cortex-A5 Industrial IoT Gateway

Hardware Guide



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Artila

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Document Amendment History

Revision	Date	Remark
V 1.0	2018 Apr.	Initial

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1. Introduction

Matrix-713, a reliable industrial IoT gateway, based on ARM Cortex-A5, is highly integrated, Linux-Ready with wide-range Temperature operating. It provides an ideal building block that easily integrates with a versatile application, such as industrial control, automation, power management and others.

1.1 Features

- ATMEL ATSAMA5D35 536MHz Cortex-A5 Processor
- Linux kernel 4.14.x and file system
- Support Toolchain: gcc 6.2.x + glibc 2.24
- Support Node-Red, the browser-based flow editor
- 512MB LPDDR2 SDRAM
- 8GB eMMC Flash and 8MB DataFlash for system backup
- 1 x Micro-SD socket
- 1 x Gigabit Ethernet and 1 x 10/100Mbps Ethernet
- Rich I/Os: 4xisolated RS-485, 2xCAN, 2xUSB,2xDI, 2xDO
- Support GNSS (GPS & GIONASS), Gyro, G-Sensor, e-Compass
- 2 x miniPCIe slot & 2 x micro-SIM card socket reserved
- +9 to +48VDC power input
- Rugged Design, Wide-range Temperature operating
- Ultra-low power consumption, less than 3 Watts
- Wall-mounting, Optional DIN RAIL mounting adaptor

1.2 Specifications (Hardware)

CPU / Memory

- CPU: ATMEL ATSAMA5D35 536MHz w/MMU
- SDRAM: 512MB, LPDDR2
- Flash: 8GB, eMMC
- DataFlash: 8MB, for system backup

Network Interface

- Type: 1 x Gigabit and 1 x 10/100Mbps Ethernet
- Connector Type: RJ45

USB 2.0 Host Interface

- Host Ports: 2
- Supports 480Mbps hi-speed mode

CAN Bus Ports

- Type: 2 x CAN Bus 2.0 A/B compliant ports
- Speed: Up to 1Mbps
- Isolation: 2500Vrms
- CAN 1: 1~2 pin, CAN 2: 3~4 pin, GND: 5pin

TTY (Serial) Ports

- 4 x Isolated RS-485 (1500Vrms isolation), P1 ~ P3
- Port 4 (P4) support RS-485 / RS-422 (selectable)
- Direction Control: Auto, by hardware
- Connector: Terminal block

Console / Debug Ports

- Support micro-USB console port
- Serial console port (inside the box)

Audio Out

- 1 x Line-out R/L port, optional Earphone R/L
- Connector: Earphone-Jack
- Support MP3 and WAV format

SD Slot

- SD 2.0 compliant, supports SDHC
- 1 x microSD socket
- Storage capacity: Support up to 64G

Digital Input

- 2 x Digital Input channels
- Isolation Protection: 5000Vrms (Photo-Coupler)
- Logical High: 5~24VDC
- Logical Low: 0~1.5VDC

Relay Output

- 2 x Digital Output Channels (Solid state Relay)
- Solid State Relay, Normal Open (NO) Type
- Contact Rating: 80VDC@1.5A

Expansion

- 2 x miniPCIe Full-size socket
- 2 x micro-SIM card socket reserved,
Support cross-zone communication / seamless integration
- 3 x SMA-type Antenna hole reserved

Power Requirement

- Input Voltage: +9 ~ +48Vdc (terminal block)
- Typical Power Consumption: 230mA@12VDC

General

- Realtime Clock: Yes, backup by super capacitor
- Buzzer: Yes
- Watchdog: Yes
- Indicator: PWR, READY, LAN, UART, CAN, STATUS (user define)
- Dimensions (W x L x H): 160 x 118 x 35mm (6.3 x 4.64 x 1.37in)
- Weight: 340g (0.75lb)
- Operating Temperature: 0~70°C (32~158°F)
- Regulation: CE Class A, FCC Class A
- Installation: Wall mounting, DIN-rail mounting (with optional kit)

1.3 Specifications (Software)**Operation System**

- Linux kernel 4.14.x
- Supports bootup from eMMC or SD card
- Boot Loader: Barebox
- File System: EXT4

Software Development

- Toolchain: gcc 6.2.x + glibc 2.24
- 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

Software Operating & Utility

Please refer to “M-A5D35” SoM (System on Module) information for software operating & utility at following: <http://www.artila.com/download/A5D35/Linux/>

1.4 GNSS / IMU Specification**GNSS (Global Navigation Satellite System)**

- 72-channel u-blox M8 GNSS engine
- Support Dual Satellite: GPS & GLONASS
- -146dBm Tracking and Navigation Sensitivity
- Support AssistNow Online/Offline/Autonomous, OMA SUPL & 3GPP Compliant
- Max nav. update rate: Single channel/up to 18MHz, 2 Concurrent GNSS /up to 10MHz
- Accuracy (Position): 2.5m CEP
- 1 x Active Antenna

IMU (Inertial Measurement Unit)

- 1 x 3-Axis digital output Gyroscope
- Gyroscope has a programmable full-scale range of ± 250 , ± 500 , ± 1000 , and ± 2000 degrees/sec and very low rate noise at 0.01dps/Hz. Gyroscope operating current: 3.2mA
- 1 x 3-Axis Accelerometer (G-Sensor)
 $\pm 2/\pm 4/\pm 8/\pm 16$ g user-programmable accelerometer full-scale range 16-bit data output
- 1 x 3-Axis Magnetometer (E-Compass)
Build-in A to D converter for magnetometer data out 16bit data each 3-Axis magnetic component (Sensitivity 0.15uT/LSB-typ.)

1.5 Packing List

- **Matrix-713:** Linux-ready Cortex-A5 536MHz Industrial IoT Gateway with 512MB SDRAM, 8GB eMMC Flash

1.6 Optional Accessory

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

1.7 Cellular Module Parameters

For Europe/Asia /LATAM

- LTE(4G) support B1(2100)/B3(1800)/B7(2600)/B8(900)/ B20(800DD)/ B38(TDD2600)/B40(TDD2300), data rate at 50Mbps(UL)/ 100Mbps(DL)
- UMTS(3G) support B1(2100)/B8(900), Data rate at 5.76Mbps(UL)/42Mbps(DL)
- 2G support 900/1800MHz
- Certification: CE

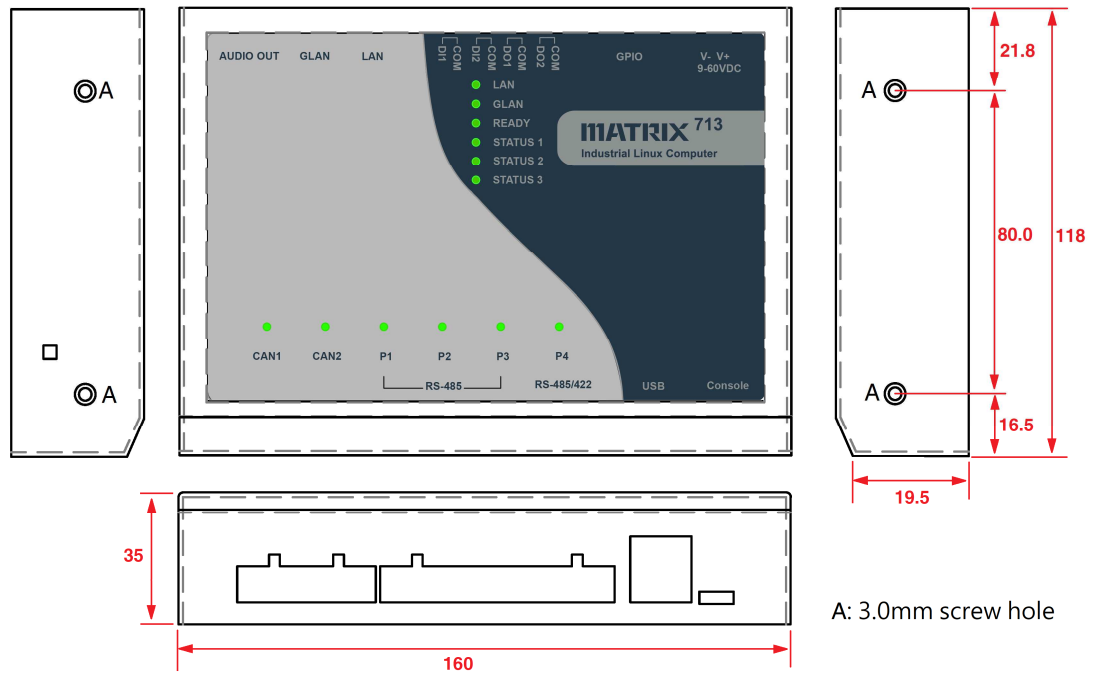
For North America

- LTE(4G) support B2(1900)/B4(1700 AWS)/B5(850)/B17(700bc), data rate at 50Mbps(UL)/100Mbps(DL)
- HSPA(3G) support B2(1900)/B5(850), Data rate at 5.76Mbps(UL)/42Mbps(DL)
- Carrier License: AT&T, Certification: FCC

For China

- LTE(4G) support B1(2100)/B3(1800)/B8(900)/B38(TDD2600)/B39(TDD1900)/ B40(TDD2300)/ B41(TDD2500), data rate at 50Mbps(UL)/100Mbps(DL)
- HSPA(3G) support B1(2100)/B8(900), Data rate at 5.76Mbps(UL)/42Mbps(DL)
- 2G support 900/1800MHz,
- Certification: CCC

2. Layout



3. Pin Assignment and Definitions

3.1 Multi-function Reset Button

The Matrix-713 provides a multi-function reset button located on the right side of the chassis shown below

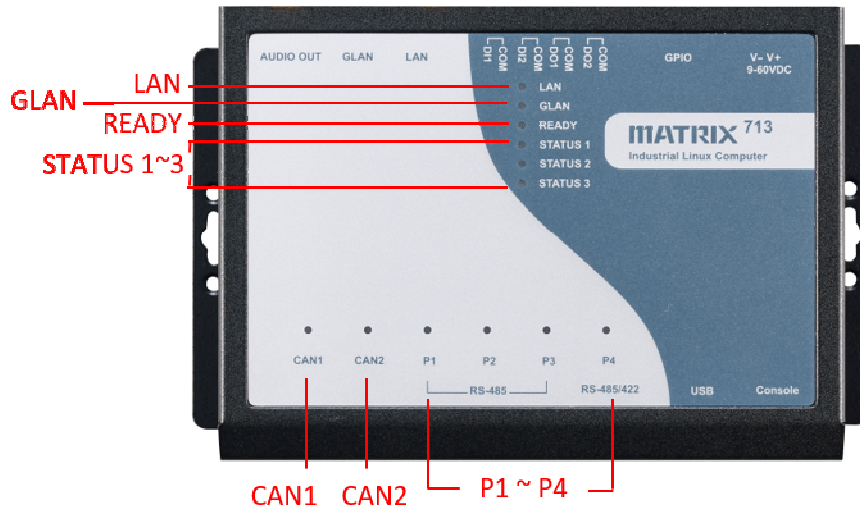


The behavior of the reset button depends on how long you press the reset button.

Press and hold the reset button	Behavior	Network settings after reboot
< 3 seconds then release	will re-boot the Matrix-713	Retains last user settings
3~10 seconds then release	will reset the network setting to the factory default	eth0 IP: addr. by DHCP eth1 IP: IP192.168.2.127
> 10 seconds then release	will re-boot the Matrix-713 and restore the FW image from the SD card (If image not exist or incorrect will cause system boot up fail.)	eth0 IP: addr. by DHCP eth1 IP: IP192.168.2.127

3.2 LED Indicators

The LED provides the Matrix-713 operation information. The LED status is described as follow:



- **“LAN” & “GLAN”** (Network LED indicator): Link and Activity LED will turn ON when the Ethernet cable is connected. When there is network data traffic, this LED will flash.
- **“READY”** (Ready LED indicator): Ready LED keeps ON when system is ready for operating.
- **“STATUS 1, STATUS 2, STATUS 3”**: Three User define LED indicator, function / activity is assigned by user.
- **“CAN1” & “CAN2”** (CAN bus LED indicator): Link and Activity LED will turn ON when the CAN bus is active. This LED will flash while data communicating.
- **“P1 ~ P4”** (Serial Port LED indicator): These four dual color LEDs indicate the data traffic at the serial ports. When RXD line is high then Green light is ON and when TXD line is high, Yellow light is ON.

3.3 CAN Bus Port

The Matrix-713 comes with two CAN bus ports.



CAN1 CAN2
CAN1_Hi, CAN1_Lo, CAN2_Hi, CAN2_Lo, GND

Users can open the CAN bus ports as network sockets, the socket names are ‘can0’ and ‘can1’ respectively.

Port Label.	CAN1	CAN2
Socket Mapping	can0	can1

Pin assignment of CAN Bus Port

Pin	5	4	3	2	1
Signal	GND	CAN2_Lo	CAN2_Hi	CAN1_Lo	CAN1_Hi



Enable/Disable Termination resistor for CAN bus

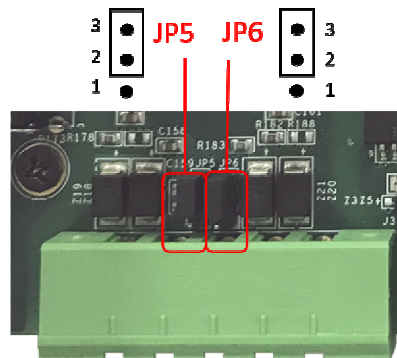
The Matrix-713 provides on-board 120Ohm termination resistor for each CAN port.

Default setting is “Disable” the terminal resistor for CAN bus.

To enable the termination resistor, please remove the upper cover of the Matrix-713, and the adjust the associated jumper to short position1 and position 2, shown below:

CAN Port No.	CAN1	CAN2
Jumper No.	JP5	JP6

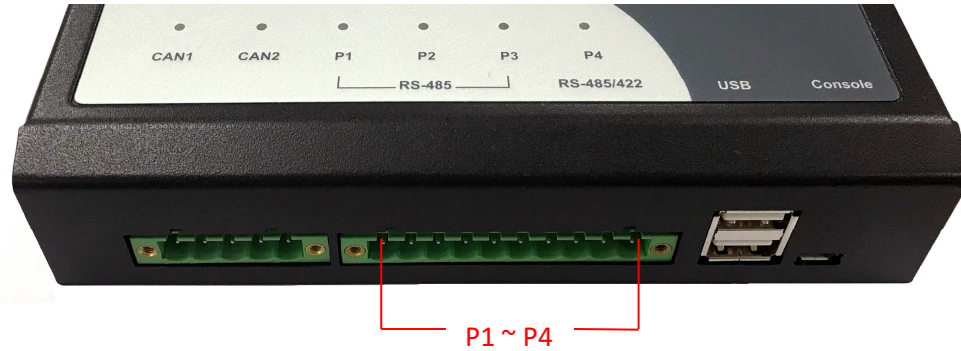
Termination Resistor Disabled (Default)	
Termination Resistor Enabled	



3.4 Serial Port

The Matrix-713 provide total four RS-485 ports with automatic direction control, also with 1500Vrms isolation protection.

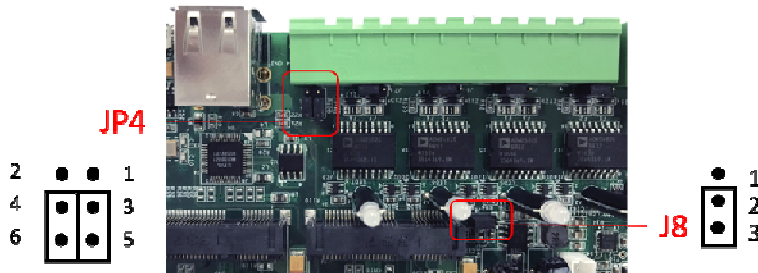
Meanwhile, P4 can be set as RS-422 using the connector labeled 'RS-485/422'.



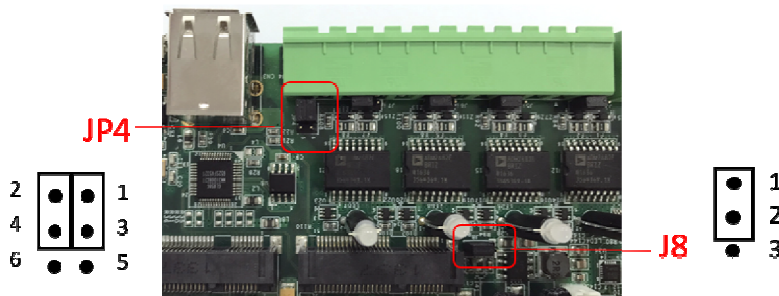
3.4.1 RS-485/RS422 Selection (JP4 & J8)

RS-485 / RS-422 (P4) can be selected by setting jumper at JP4 & J8 (JP4 and J8 must be setting at the same time.)

RS-485 (Default): Setting JP4 at pin3/5, pin4/6 short and J8 P2/3 short



RS-422: Setting JP4 at pin1/3, pin2/4 short and J8 P1/2 short



3.4.2 Pin assignment of RS-485/RS422

P1		P2		P3		P4	
D+	D-	D+	D-	D+	D-	D+	D-

The pin assignment is shown as following table.



Port No.	P1	P2	P3
RS-485	1500Vrms Isolation protection		
Device Mapping	ttyS1	ttyS2	ttyS3

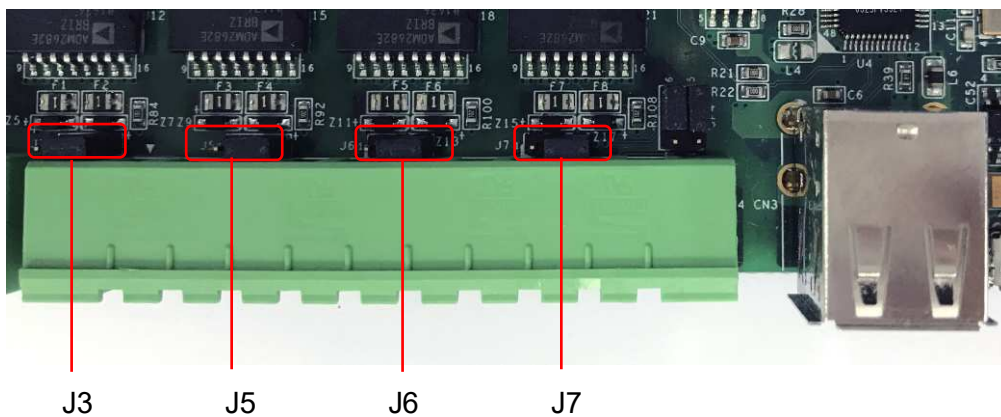
Port No.	P4
RS-485/RS-422	1500Vrms Isolation protection
Device Mapping	ttyS4

3.4.3 Enable/Disable Termination resistor for RS-485

The Matrix-713 provides on-board 120Ohm termination resistor for each RS-485 port. To enable the termination resistor, please remove the upper cover of the Matrix-713, and the adjust the associated jumper to short position1 and position 2, shown below:

Port No.	P1	P2	P3	P4
Jumper No.	J3	J5	J6	J7

Termination Resistor Disabled (default)	
Termination Resistor Enabled	



3.5 USB Port

Two type-A USB 2.0 ports are built for operation.

3.6 Serial Console Port

There is a Micro-USB connector which acts as serial console port. Typically, a console is accessed from Computer over an Micro-USB connection.

3.7 Audio Port

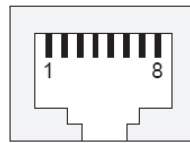
One Audio Out port with line-out Jack as sound out. It allows external speakers, headphones, or other output devices to be connected to, transferring audio to the devices so that it can be heard.

3.8 Ethernet LAN Port

The Ethernet Port use RJ45 connector for both 10/100LAN port and GigaLAN port.

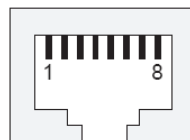
Pin definition of 10/100Base-T LAN port

PIN	Signal
1	ETX +
2	ETX -
3	ERX +
6	ERX -



Pin definition of GigaLAN port

PIN	Signal
1	ETX1 +
2	ETX1 -
3	ERX1 +
6	ERX1 -
4	ETX2 +
5	ETX2 -
7	ERX2 +
8	ERX2 -



3.9 Digital Input

Two channel Digital Input are equipped with 5000Vrms photocoupler isolation which share the same common ground.

The specification of the isolated input channels is:

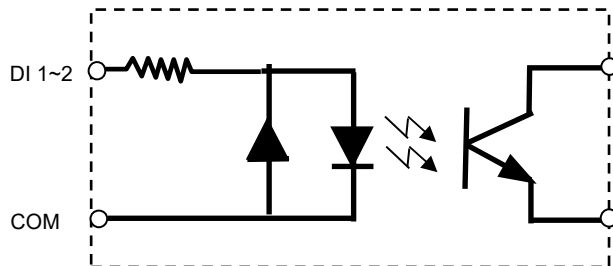
Logical High: 5~24Vdc

Logical Low: 0~1.5Vdc

Input resistance: 1.8KOhms@0.32W

Response time: 20 μ s

Isolation: 5000Vrms

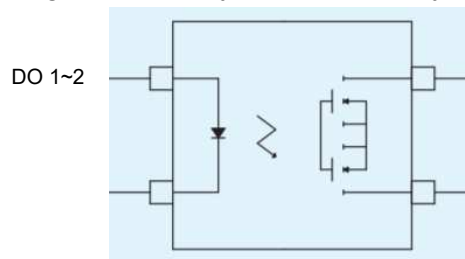


DIx: Isolated digital input channels.

COM: Common ground.

3.10 Digital Out

Two channel Digital Output by solid state relay.



3.11 GPIO

Four General-purpose input/output (GPIO) is reserved for user's definition / application.

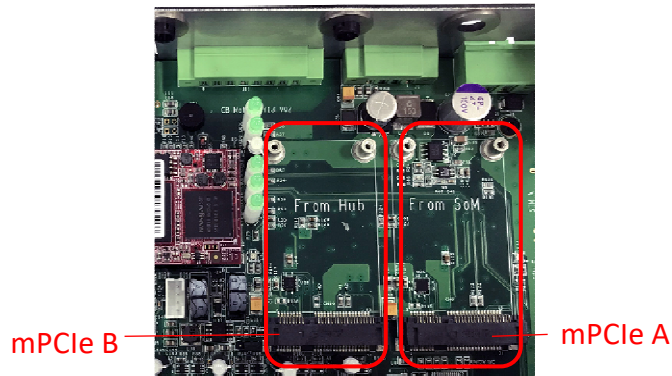
3.12 Power Connector

Connecting +9 ~ +48VDC power line to the Power in terminal block.

3.13 miniPCle socket

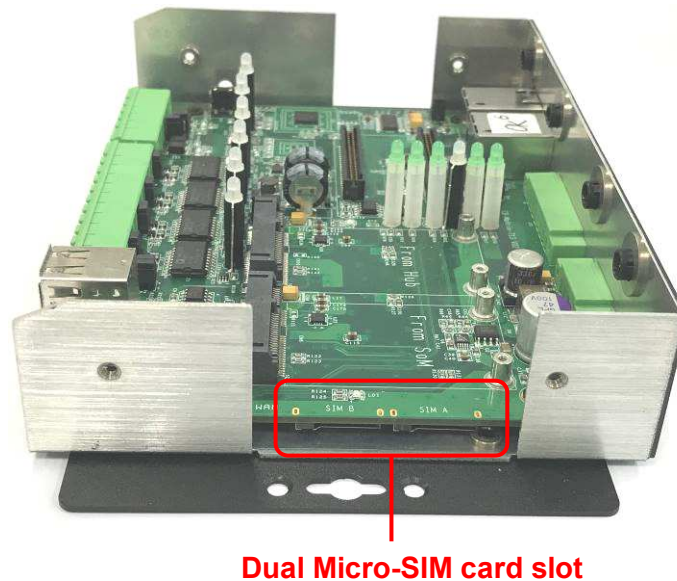
There comes with two miniPCle socket: mPCle A & mPCle B

- Interface: USB
- mPCle A: USB host signal connected to SOM (M-A5D35) directly
- mPCle B: USB host signal is through USB Hub-IC



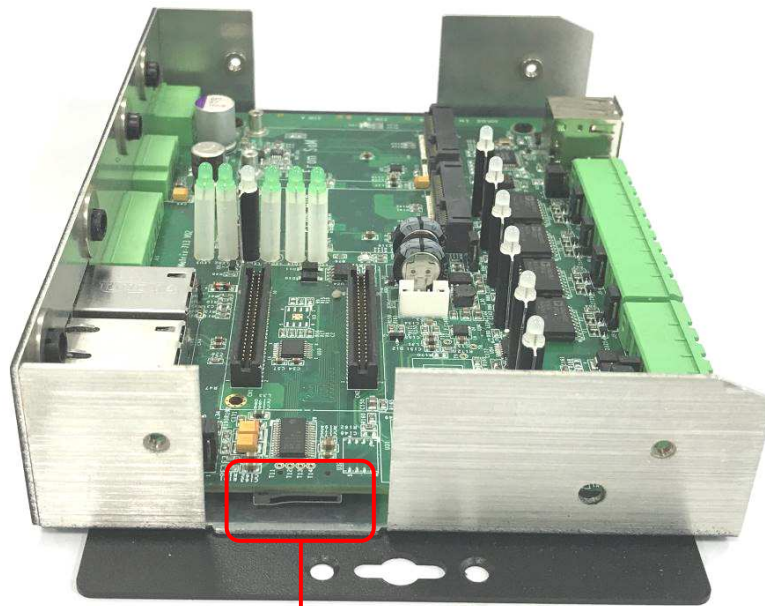
3.14 Micro-SIM socket

Dual SIM card socket reserved for communication/networking functionality.
It supports cross-zone communication / seamless integration



3.15 SD card socket

There is a SD card socket inside as data storage. It can be accessed by opening top cover.



SD Card Socket