Embedded MXM module

M3A500-PP Series

USER MANUAL

Document Change History

Version	Date	Description	Authors
V1.0	2023/03/15	Initial Release.	Emily Chou
V1.1	2023/05/10	Revised Board configuration and Ordering info.	Emily Chou

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Customer Support Overview

Contact your distributor, sales representative, or Aetina's customer service center for technical support if you need additional assistance. Please have the following information ready:

- – Product name and serial number
- – Description of your peripheral attachments
- – Description of your software (operating system, version, application software, etc.)
- – A complete description of the problem
- – The exact wording of any error messages

Visit the Aetina website at https://www.aetina.com where you can find the latest information about the product.

Contact Information

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Fax   +886-2-7746 1102
Mail   sales@Aetina.com

Product Warranty

Aetina warrants the original purchaser, that each of its products will be free from defects in materials and workmanship which refers to "Aetina warranty policy" on Aetina's official website: https://www.aetina.com/. Aetina warranty policy will be updated from time to time, and the last version shall be binding on the parties.

For out of warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you have a defective product, please follow those steps which refers to "Aetina RMA Service" on Aetina's official website: https://www.aetina.com/.

ESD Warning

This product, like all electronic products, uses the product that can be damaged by electrostatic discharge (ESD). When handling, care must be taken so that the devices are not damaged. Damage due to inappropriate handling is not covered by Aetina warranty policy. The following precautions must be taken:

- Do not open the protective conductive packaging until you have read the following and are at an approved anti-static workstation.
- If working on a prototyping board, use a soldering iron or station that is marked as ESD-safe.
- Always disconnect the product from the prototyping board when it is being worked on.
- Always discharge yourself by touching a grounded bare metal surface or approved anti-static mat before picking up an ESD - sensitive electronic component.
- Use an approved anti-static mat to cover your work surface.

Safety Precautions

Please read the following safety instructions carefully. It is advised that you keep this manual for future references:

1. All cautions and warnings on the equipment should be noted.
2. Make sure the power source matches the power rating specifications of the device.
3. Position the power cord away from obstructions and avoid stepping on it. Do not place anything over the power cord.
4. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
5. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
6. Always completely disconnect the power before working on the system's hardware.

7. Keep this equipment away from humidity.

8. Put this equipment on a reliable surface during installation. Dropping it or letting it fall may cause damage.

9. The openings on the enclosure are for air convection. Protect the equipment from overheating. DO NOT COVER THE OPENINGS.

10. Be sure that the room in which you choose to operate your system has adequate air circulation. Ensure that the chassis cover is secure.

11. The chassis design allows cooling air to circulate effectively. An open chassis permits air leaks, which may interrupt and redirect the flow of cooling air from internal components.

12. Never pour any liquid into an opening. This may cause fire or electrical shock.

13. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.

14. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.

15. If any of the following situations arises, please the contact Aetina's service personnel:

    –   Power cord or plug is damaged
    –   Liquid intrusion to the device
    –   Exposure to moisture
    –   Device is not working as expected or in a manner as described in this manual
    –   The device is dropped or damaged
    –   Any obvious signs of damage displayed on the device

Contents

1. Product Specification

The MXM M3A500-PP module features advanced NVIDIA RTX A500 Embedded GUP. It's Ampere architecture in the MXM 3.1 Type A form factor. With 2048 CUDA core, 16 RT cores and 64 Tensor cores, 4GB GDDR6 memory. The M3A500-PP support PCIe Gen 4 interface is delivers faster sequential data transfer than PCIe Gen 3 interface and bringing excellent performance and power efficiency into a wide variety of embedded systems, fully integrating hardware acceleration for both graphics and computing code, enabling hardware acceleration for a wider class of software applications than ever before.

The NVIDIA RTX A500 supports operability in an extended temperature range of -40°C to 85°C, suitable for mission-critical harsh environments. It provides graphics intensive acceleration and real time ray-tracing capability for applications like scientific and medical visualization, digital content creation (DCC), artificial intelligence (AI) and machine learning (ML).

NVIDIA RTX A500 does not support direct display through the DP link. With NVIDIA's new Optimus/ MS Hybrid technology, users can now experience the full performance benefits of a discrete GPU of NVIDIA RTX A500 with the battery life of an integrated graphics solution. NVIDIA Optimus automatically, instantaneously, and seamlessly optimizes the notebook to offer the best performance or best battery life depending on the application.
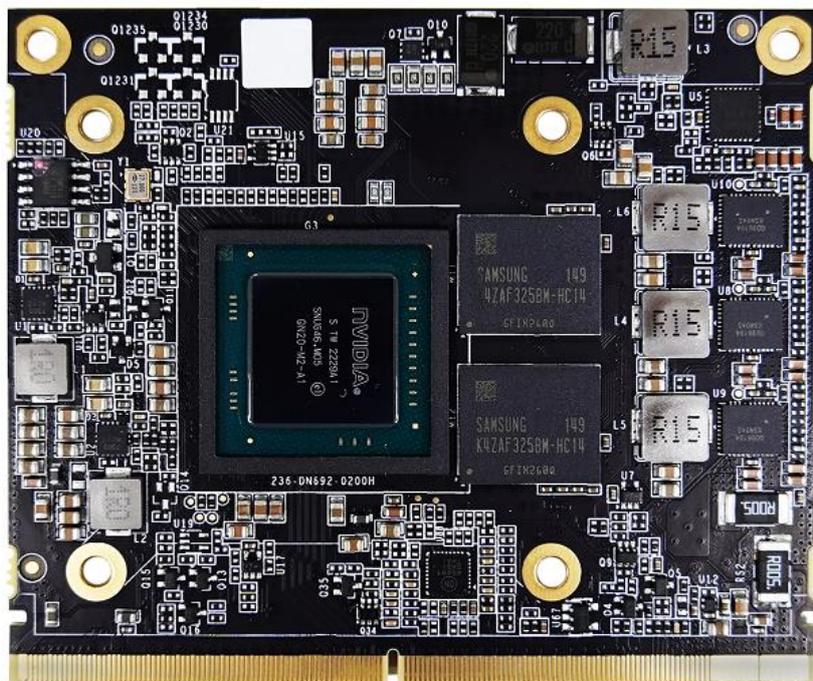
1.1 Features

- Powered by NVIDIA Ampere architecture
- 2048 CUDA cores, 16 RT cores and 64 Tensor cores, 4GB GDDR6
- 7.28 TFLOPS peak FP32 performance
- PCIe Gen 4 x4 interface
- 5 years longevity product supply service

  - **GPU**
    - NVIDIA RTX A500 Embedded GPU
    - Stream Processing Unites: 2048
    - Voltage: Variable

  - **Board**
    - 12-layer printed circuit board (PCB)
    - 16-lanes PCI Express 4.0 capable[1]
    - Physical dimensions: 70mm x 82mm
    - Board power: 45 W

  - **Connectors**
    - MXM 3.1 Connector Interoperability

  - **Memory Configuration**
    - Memory clock: 7000 MHz (14.0 Gbps)
    - Interface: 64-bit
    - Local frame buffer: 4GB (2 pieces 512M x 32 GDDR6, FBGA-180 package)

  - **Display Support**
    - N/A (MS Hybrid version)

  - **Cooling System**
    - N/A

  - **Operating System Support**
    - Windows® 10-11 64-bit
    - Linux 64-bit

1- Aetina provides PCI Express Gen4.0 x4.

1.2 Configuration

Lists the SKU configuration currently available for the NVIDIA RTX A500 graphics board.

■ **Board configuration**

Specification	M3A500-PPA-A1	M3A500-PPA-A2
Chip	NVIDIA RTX A500 Embedded GPU	
Core clock(MHz)	Base=1155 Boost= 1777	Base=652 Boost= 1597
Memory speed	14.0 Gbps	
Frame buffer	4GB GDDR6	
Memory interface	64-bit	
Memory type	512M x 32 GDDR6 FBGA-180 package	
Memory AVL	Samsung K4ZAF325BM-HC14	
Maximum board power	45 W	35 W
Connectors	N/A (MS Hybrid version)	
Supplementary Power Connector	N/A	
Maximum output	N/A	
HDCP support	N/A	
Operating Temperature	0 to +55 °C	
Wide Temperature	By request	
Operating Humidity	10~90%, Non-condensing.	

2. Hardware Information

2.1 Block Diagram

The Aetina M3A500-PP is based on PCI Express 4.0 form factor.
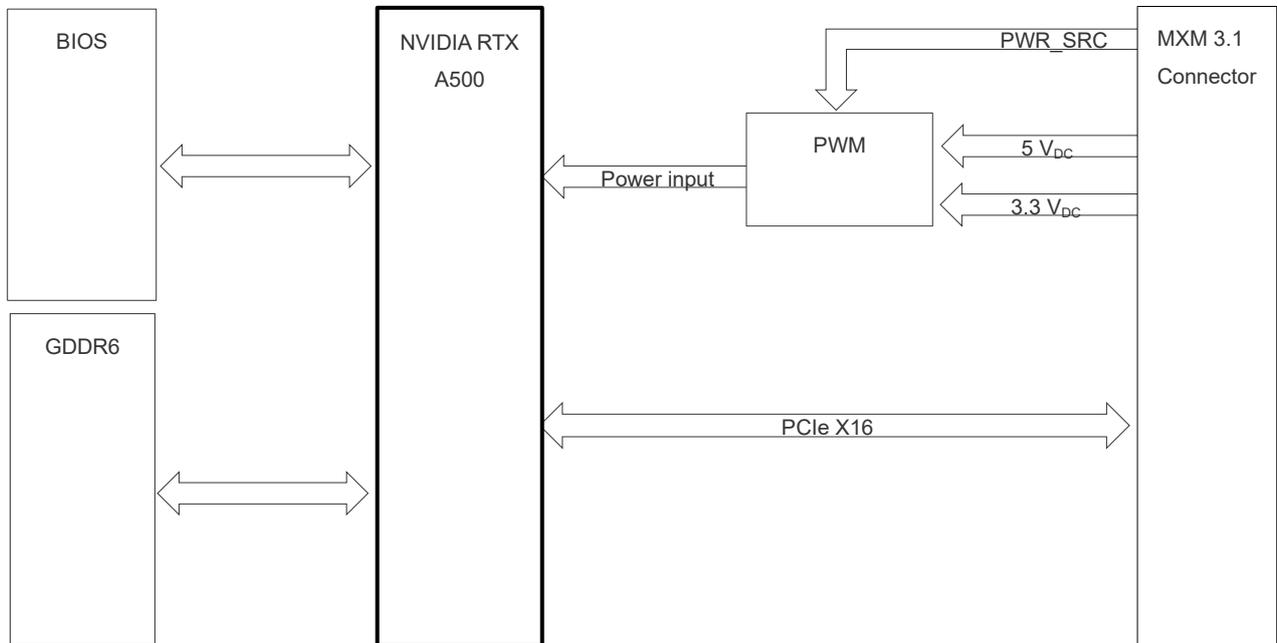
M3A500-PP Block diagram

2.2 General Purpose Graphics Processing Unit

The Aetina M3A500-PP is based on NVIDIA RTX A500 Embedded GPU. The A500 is compliant with NVIDIA's CUDA computing capability 8.6.

- **GPU Resources**
  - GDDR6 SDRAM
    - 2 pieces 512M x 32 GDDR6, total capacity of 4096 Mbytes
    - 64bit data bus width
    - 14.0 Gbps clock frequency

  - BIOS ROM
    - 8Mbit SPI FLASH for BIOS image

2.3 Display Interface

The M3A500-PP provides four the digital output channels can be active at the same time.

- Digital Output
  - o   This model does not support Digital output.

- Analog Output
  - o   This model does not support Analog output.

- Hot Plug
  - o   This model does not support Hot Plug detect for digital monitors.

2.4 PCIE Express

The M3A500-PP provides PCI Express Gen4.0 x4.

2.5 Mechanical Dimensions
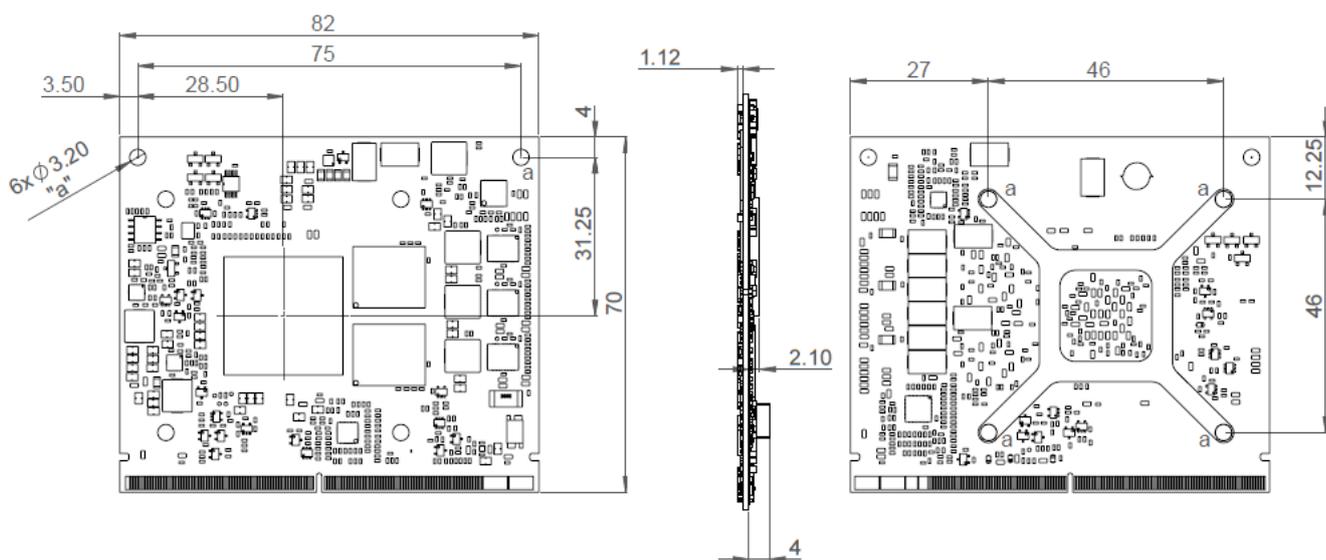
Dimensions of M3A500-PP

2.6 Pin Definition

- Board Interface
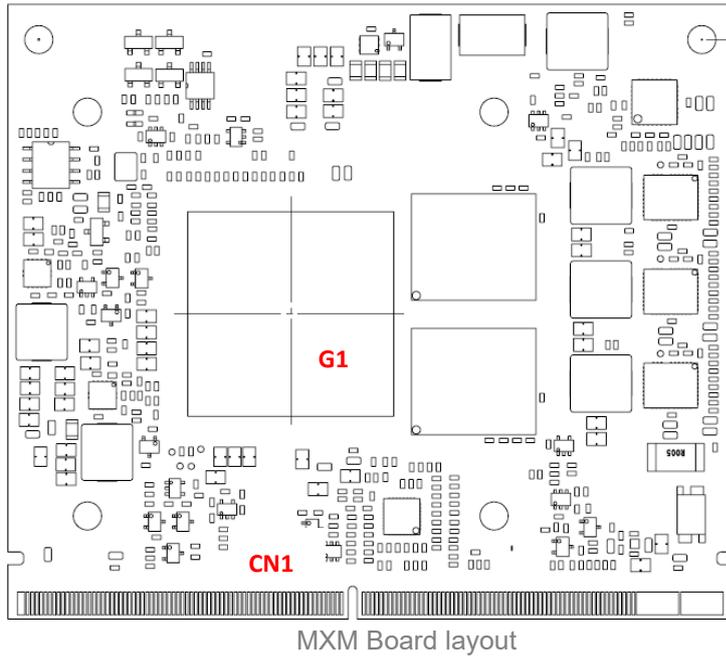
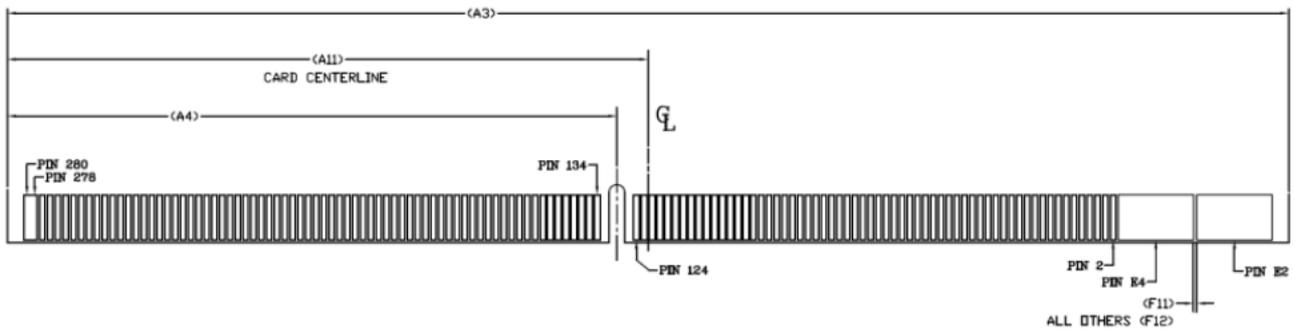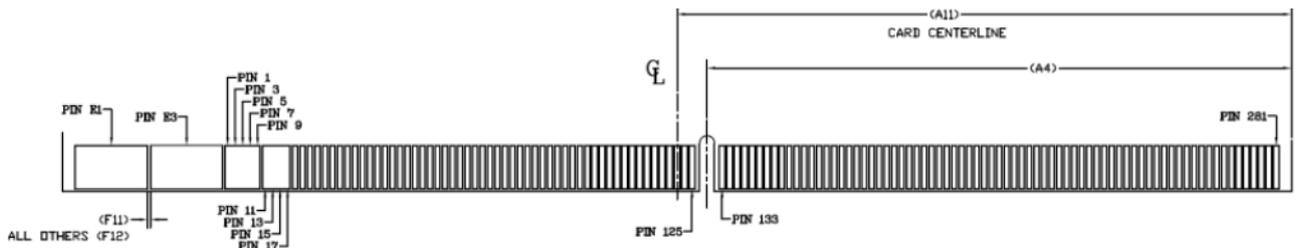MXM Board layout

Specification	Describe
G1	NVIDIA RTX A500 GPU
CN1	MXM connector (Golden finger)

Board layout and connectors

- MXM Pin Assignments

MXM connector (card TOP)

MXM connector (card BOTTOM)

- **MXM connector Pinout**

Pin	Signal (bottom)	Pin	Signal (top)	Pin	Signal (bottom)	Pin	Signal (top)
E1	PWR_SRC	E2	PWR_SRC	141	PEX_RX1#	142	PEX_TX1#
E3	GND	E4	GND	143	PEX_RX1	144	PEX_TX1
1	5V	2	PRSNT_R#	145	GND	146	GND
3	5V	4	WAKE#	147	PEX_RX0#	148	PEX_TX0#
5	5V	6	PWR_GOOD	149	PEX_RX0	150	PEX_TX0
7	5V	8	PWR_EN	151	GND	152	GND
9	5V	10	27MHZ_REF (n.c.)	153	PEX_REFCLK#	154	PEX_CLK_REQ#
11	GND	12	GND	155	PEX_REFCLK	156	PEX_RST#
13	GND	14	LVDS_U_HPD, DP_E_HPD (n.c.)	157	GND	158	VGA_DDC_DAT (n.c.)
15	GND	16	PCH_RST*	159	JTAG_TDO (n.c.)	160	VGA_DCC_CLK (n.c.)
17	GND	18	PWR_LEVEL	161	JTAG_TDI (n.c.)	162	VGA_VSYNC (n.c.)
19	PEX_STD_SW#	20	TH_OVERT#	163	JTAG_TCLK (n.c.)	164	VGA_HSYNC (n.c.)
21	VGA_DISABLE# (n.c.)	22	TH_ALERT#	165	JTAG_TMS (n.c.)	166	GND
23	PNL_PWR_EN (n.c.)	24	TH_PWM	167	JTAG_TRST# (n.c.)	168	VGA_RED (n.c.)
25	PNL_BL_EN (n.c.)	26	GPIO0 (n.c.)	169	DP_F_L3# (n.c.)	170	VGA_GREEN (n.c.)
27	PNL_BL_PWN (n.c.)	28	GPIO1 (n.c.)	171	DP_F_L3 (n.c.)	172	VGA_BLUE (n.c.)
29	HDMI_CEC (n.c.)	30	GPIO2 (n.c.)	173	GND	174	GND
31	LVDS_L_HPD, DP_E_HPD (n.c.)	32	SMB_DAT	175	DP_F_AUX# (n.c.)	176	DP_E_L3# (n.c.)
33	LVDS_DDC_DAT (n.c.)	34	SMB_CLK	177	DP_F_AUX (n.c.)	178	DP_E_L3 (n.c.)
35	LVDS_DDC_CLK (n.c.)	36	GND	179	GND	180	GND
37	GND	38	OEM0 (n.c.)	181	DP_F_L0# (n.c.)	182	DP_E_AUX# (n.c.)
39	OEM1 (n.c.)	40	OEM2 (n.c.)	183	DP_F_L0 (n.c.)	184	DP_E_AUX (n.c.)
41	OEM3 (n.c.)	42	OEM4 (n.c.)	185	GND	186	GND
43	OEM5 (n.c.)	44	OEM6 (n.c.)	187	DP_F_L1# (n.c.)	188	DP_E_L0# (n.c.)
45	OEM7, GPIO5_FEAME_LOCK_INT	46	GND	189	DP_F_L1 (n.c.)	190	DP_E_L0 (n.c.)
47	GND	48	PEX_TX15# (n.c.)	191	GND	192	GND
49	PEX_RX15# (n.c.)	50	PEX_TX15 (n.c.)	193	DP_F_L2# (n.c.)	194	DP_E_L1# (n.c.)
51	PEX_RX15 (n.c.)	52	GND	195	DP_F_L2 (n.c.)	196	DP_E_L1 (n.c.)
53	GND	54	PEX_TX14# (n.c.)	197	GND	198	GND
55	PEX_RX14# (n.c.)	56	PEX_TX14 (n.c.)	199	DP_C_L0# (n.c.)	200	DP_E_L2# (n.c.)
57	PEX_RX14 (n.c.)	58	GND	201	DP_C_L0 (n.c.)	202	DP_E_L2 (n.c.)
59	GND	60	PEX_TX13# (n.c.)	203	GND	204	GND
61	PEX_RX13# (n.c.)	62	PEX_TX13 (n.c.)	205	DP_C_L1# (n.c.)	206	DP_D_L0# (n.c.)
63	PEX_RX13 (n.c.)	64	GND	207	DP_C_L1 (n.c.)	208	DP_D_L0 (n.c.)
65	GND	66	PEX_TX12# (n.c.)	209	GND	210	GND
67	PEX_RX12# (n.c.)	68	PEX_TX12 (n.c.)	211	DP_C_L2# (n.c.)	212	DP_D_L1# (n.c.)
69	PEX_RX12 (n.c.)	70	GND	213	DP_C_L2 (n.c.)	214	DP_D_L1 (n.c.)
71	GND	72	PEX_TX11# (n.c.)	215	GND	216	GND
73	PEX_RX11# (n.c.)	74	PEX_TX11 (n.c.)	217	DP_C_L3# (n.c.)	218	DP_D_L2# (n.c.)
75	PEX_RX11 (n.c.)	76	GND	219	DP_C_L3 (n.c.)	220	DP_D_L2 (n.c.)

MXM connector pinout (continued)

Pin	Signal (bottom)	Pin	Signal (top)	Pin	Signal (bottom)	Pin	Signal (top)
77	GND	78	PEX_TX10# *(n.c.)*	221	GND	222	GND
79	PEX_RX10# *(n.c.)*	80	PEX_TX10 *(n.c.)*	223	DP_C_AUX# *(n.c.)*	224	DP_D_L3# *(n.c.)*
81	PEX_RX10 *(n.c.)*	82	GND	225	DP_C_AUX *(n.c.)*	226	DP_D_L3 *(n.c.)*
83	GND	84	PEX_TX9# *(n.c.)*	227	*(n.c.)*	228	GND
85	PEX_RX9# *(n.c.)*	86	PEX_TX9 *(n.c.)*	229	*(n.c.)*	230	DP_D_AUX# *(n.c.)*
87	PEX_RX9 *(n.c.)*	88	GND	231	*(n.c.)*	232	DP_D_AUX *(n.c.)*
89	GND	90	PEX_TX8# *(n.c.)*	233	*(n.c.)*	234	DP_C_HPD *(100K PD) (n.c.)*
91	PEX_RX8# *(n.c.)*	92	PEX_TX8 *(n.c.)*	235	SNN_RSVD_15_MXM *(n.c.)*	236	DP_D_HPD *(100K PD) (n.c.)*
93	PEX_RX8 *(n.c.)*	94	GND	237	SNN_RSVD_16_MXM *(n.c.)*	238	SNN_RSVD_18_MXM *(n.c.)*
95	GND	96	PEX_TX7#	239	SNN_RSVD_19_MXM *(n.c.)*	240	3V3
97	PEX_RX7#	98	PEX_TX7	241	SNN_RSVD_20_MXM *(n.c.)*	242	3V3
99	PEX_RX7	100	GND	243	SNN_RSVD_21_MXM *(n.c.)*	244	GND
101	GND	102	PEX_TX6#	245	SNN_RSVD_22_MXM *(n.c.)*	246	DP_B_L0# *(n.c.)*
103	PEX_RX6#	104	PEX_TX6	247	MXM_THERMDP_GPU	248	DP_B_L0 *(n.c.)*
105	PEX_RX6	106	GND	249	MXM_THERMDN_GPU	250	GND
107	GND	108	PEX_TX5#	251	GND	252	DP_B_L1# *(n.c.)*
109	PEX_RX5#	110	PEX_TX5	253	DP_A_L0# *(n.c.)*	254	DP_B_L1 *(n.c.)*
111	PEX_RX5	112	GND	255	DP_A_L0 *(n.c.)*	256	GND
113	GND	114	PEX_TX4#	257	GND	258	DP_B_L2# *(n.c.)*
115	PEX_RX4#	116	PEX_TX4	259	DP_A_L1# *(n.c.)*	260	DP_B_L2 *(n.c.)*
117	PEX_RX4	118	GND	261	DP_A_L1 *(n.c.)*	262	GND
119	GND	120	PEX_TX3#	263	GND	264	DP_B_L3# *(n.c.)*
121	PEX_RX3#	122	PEX_TX3	265	DP_A_L2# *(n.c.)*	266	DP_B_L3 *(n.c.)*
123	PEX_RX3	124	GND	267	DP_A_L2 *(n.c.)*	268	GND
125	GND	126	*KEY*	269	GND	270	DP_B_AUX# *(n.c.)*
127	*KEY*	128	*KEY*	271	DP_A_L3# *(n.c.)*	272	DP_B_AUX *(n.c.)*
129	*KEY*	130	*KEY*	273	DP_A_L3 *(n.c.)*	274	DP_B_HPD *(100K PD) (n.c.)*
131	*KEY*	132	*KEY*	275	GND	276	DP_A_HPD *(100K PD) (n.c.)*
133	GND	134	GND	277	DP_A_AUX# *(n.c.)*	278	3V3
135	PEX_RX2#	136	PEX_TX2#	279	DP_A_AUX *(n.c.)*	280	3V3
137	PEX_RX2	138	PEX_TX2	281	PRSNT_L#		
139	GND	140	GND				

MXM connector pinout

Notes:

1. KEY = Key (or notch) on the PCB edge finger

2. PD = Pull-down resister on module

3. n.c. = Not Connect

4. Reserved = Reserved pin and do NOT connect on system

3. Software Installation

Before you begin installing your new graphics card, please make sure you have the proper system requirements and have completed the required pre-installation tasks as outlined in this chapter.

3.1 System Recommended

- AMD Ryzen 7 or Intel Core i7 processor or latest.
- 16GB of system memory; 24GB or more recommended for better performance.
- Motherboard with available PCI Express® 4.0 ×16 lane MXM connection slot.
- Internet access for software installation.
- NVIDIA RTX A500 Embedded GPU supports resizable BAR1. SBIOS should support "Above 4GB decoding" feature to support resizable BAR1 size.
- Operating System:
  - Windows® 7 - 11 64-bit
  - Linux® 64-bit

3.2 Performing a Quick Installation

Experienced users and system administrators can follow these brief instructions for installing Aetina graphics card. Other users should refer to the detailed installation instructions.

1. Uninstall the drivers and software for any installed graphics card(s).
2. Shut down and disconnect your computer system.
3. Remove any installed graphics card(s).
4. Install your new Aetina graphics card.
5. Reassemble and connect your computer system.
6. Install the Aetina graphics drivers from the Aetina official website.

*Note: If you are using a motherboard containing an on-board graphics solution and do not intend to use it as part of a multiple monitor display, disable it.

3.3 Install Graphics Driver

Notice the following guidelines before installing the drivers:

    1. First uninstall previous graphics card driver.

    2. Make sure your system has installed DirectX 11 or later version.

    3. Make sure your system has installed the appropriate motherboard drivers (for the motherboard drivers, please contact the motherboard manufacturer).

After installing the operating system, download driver from Aetina official website. Then, go to My Computer, double-click the Download folder and execute the setup.exe program.
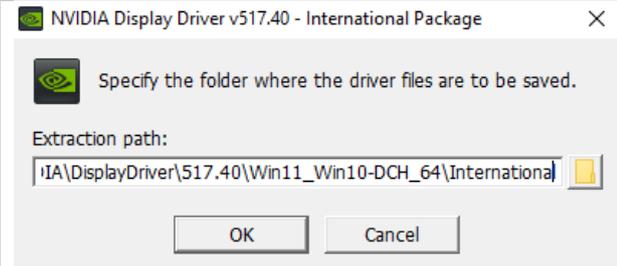
	● Click the "OK" button to install driver.
	● Click the "AGREE AND CONTINUE"
	● Choose "Express (Recommended)" or "Custom (Advanced)" then click "NEXT"
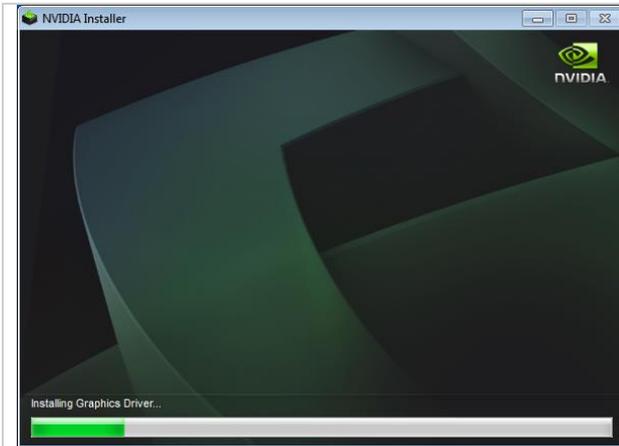
- The system is installing the components

- Click the "RESTART NOW" button to restart the computer. Then the driver installation is done

4. Initial Setup

4.1 Thermal Specifications

■ **Thermal Specification**

Parameter	Value
Thermal Resistance (Junction to Case, R_{JC})	0.042°C/W
Thermal Resistance (Junction to PCB, R_{JB})	2.38°C/W
GPU shutdown temperature (OVERT) (Note 1)	100°C
GPU shutdown temperature (THERM_ALERT) (Note 2)	98°C
GPU maximum operating temperature (Note 3)	89°C
GPU target temperature	87°C (default). 65°C (minimum)

Thermal Design Power (TDP)	Value	
Total Graphics Power (TGP)	45W	35W
GPU TDP (Note 4)	34W	26W
Memory TDP (Note 5)	10W	10W

Notes:

1. OVERT results in an 87.5% (÷8) hardware clock slowdown.

2. THERM_ALERT results in a 50% (÷2) hardware clock slowdown.

3. The GPU max operating temperature is the max GPU temperature at which the GPU is guaranteed to operate at the target performance (Base Clock) under worst case TDP test conditions

4. GPU TDP = GPU core + GPU FBIO + PCIe + IO/PLLVDD + Other. TDP is achievable when running GPU Heater if the system meets the GPU max operating temperature specification.

5. Memory TDP = Memory core + Memory IO. These values are with nominal memory and are taken without temperature control on memory. Refer to memory manufacturer for absolute ratings.

6. If the system thermal design cannot meet the TDP and TGP requirements, please contact your supplier FAE.

5. Appendix

5.1 Ordering Information

■ **Models available**

Model Number	Description
M3A500-PPA-A1	MXM-A, NVIDIA RTX A500, Gen4.0 x4, 4GB GDDR6, MSH, 45W, 0°C to +55°C
M3A500-PPW-A1	MXM-A, NVIDIA RTX A500, Gen4.0 x4, 4GB GDDR6, MSH, 45W, -40°C to +85°C
M3A500-PPA-A2	MXM-A, NVIDIA RTX A500, Gen4.0 x4, 4GB GDDR6, MSH, 35W, 0°C to +55°C
M3A500-PPW-A2	MXM-A, NVIDIA RTX A500, Gen4.0 x4, 4GB GDDR6, MSH, 35W, -40°C to +85°C

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