MXE-100i Series

MXE-101i

IoT Gateway

User's Manual

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Advance Technologies; Automate the World.

Revision History

Revision	Release Date	Description of Change(s)
2.00	May 29, 2015	Initial Release

Preface

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Take note of the following conventions used throughout this manual to make sure that users perform certain tasks and instructions properly.

Additional information, aids, and tips that help users perform tasks.

Information to prevent ***minor*** physical injury, component damage, data loss, and/or program corruption when trying to complete a task.

Information to prevent ***serious*** physical injury, component damage, data loss, and/or program corruption when trying to complete a specific task.

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1 Introduction

1.1 Overview

ADLINK's new Matrix MXE-100i ultra-compact embedded IoT gateway, based on the Intel® Quark™ SoC processor X1021, delivers reliable I/O design for maximum connectivity. A full aluminum alloy enclosure with industry-class construction makes it the embedded system of choice for industrial automation and applications demanding reliability in harsh environments.

Combined with ADLINK's embedded SEMA Cloud solution, the MXE-100i delivers manageability and robustness required by mission critical operations. In addition, the MXE-100i fully supports Intel® Gateway Solutions for the Internet of Things (IoT), integrated Wind River® Intelligent Device Platform XT, and McAfee Embedded Control, together guaranteeing the cornerstone manageability and security critical to IoT-ready platforms.

With its two Fast LAN, two COM, three USB 2.0 host ports, optional four isolated DI and four isolated DO, dual mini PCIe slots and USIM socket support communication with connections such as WiFi, BT, and 3G, the MXE-100i enables seamless interconnection, ensuring interoperability between systems. Matrix's proven rugged construction assures operation in harsh environments with operating shock tolerance up to 100 G and an extended optional operating temperature range of -20°C to 70°C.

Implementing the Intel® IoT Gateway Solution with ADLINK's SEMA, the MXE-100i maximizes manageability and security for a world of applications, delivering efficient remote monitoring of system activity and health in real time, complete control over a robust secured channel, and fully manageable utilization of system resources. All told, the MXE-100i presents an intelligent, robust embedded system supporting wide application development and easy service deployment, for outstanding performance in facility management, industrial automation, and IoT applications.

1.2 Features

- Intel® Quark™ SoC processor X1021
- Extremely compact: 120 (W) x 100 (D) x 55 (H) mm
- Rich I/O:
  - 3 x USB 2.0, 2x Fast Ethernet ports, 2x COM ports, optional 4 isolated DI/O
  - 2x mPCIe slots, 1x USIM socket, 1x SDIO
- Optional DIN-rail/wall mounting
- Included ADLINK SEMA Cloud solution
- Full support for Intel® Gateway Solutions for the Internet of Things (IoT)

1.3 Specifications

System Core	
Processor	Intel® Quark™ X1021
Chipset	SoC with processor
Console	Output via RS-232(COM1)
Memory	1GB DDR3 800MHz memory down
I/O Interface	
Ethernet	2 Fast Ethernet
Serial Ports	1x RS-232 (COM1) 1x BIOS-programmable RS-232/422/485 (Serial)
USB	3 x USB 2.0
DI/O	4 optional DI/O w/ 1.5KV isolation
Mini PCIe	2 internal PCIe mini card sockets
USIM	1 USIM socket for 3G communication (used for a 3G-mini module)
WDT	Supports watchdog timer
Power Supply	
DC Input	Built-in 6-36 VDC wide-range DC input 3P pluggable connectors with latch (GND, V-, V+)
AC Input	Optional 80 W external AC-DC adapter for AC input
Storage	
SD	1 SD slot (SD/SDHC up to 16G)
Physical	
Dimensions	120 (W) x 100 (D) x 55 (H) mm (4.68” x 3.9” x 2.17”)
Weight	650 g (1.43 lbs)
Mounting	DIN-RAIL / Wall-mount kit
Environmental	
Operating Temperature	Standard: 0°C to 50°C
Extended Temperature	-20°C to 70°C (w/ industrial SD)

Storage Temperature	-40°C to 85°C (excl. HDD/SDD/CFAST)
Humidity	~95% @ 40°C (non-condensing)
Vibration	Operating, 5 Grms, 5-500 Hz, 3 axes (w/ SD)
ESD	Contact +/-4 KV and Air +/-8 KV
Shock	Operating, 50 G, half sine 11 ms duration (w/ SD)
EMC	CE and FCC Class A
Safety	UL, CB

NOTE:

Cold boot of the system at -20°c and operation with 100% loading at 70°c is provided when the industrial solid-state drive storage option is implemented.

Power Consumption		
Power off	0.3W	In shutdown mode with DC input and only USB keyboard/mouse
System Idle	4.3W	Under OS with no application programs executed
Processor full load	6.7W	Under OS with 100% CPU utilization and 2D/3D graphics load
System full load	8.3W	Under OS with 100% CPU utilization and simultaneous access to all I/O devices
Recommended power supply	80W	With consideration of voltage de-rating under high environmental temperature

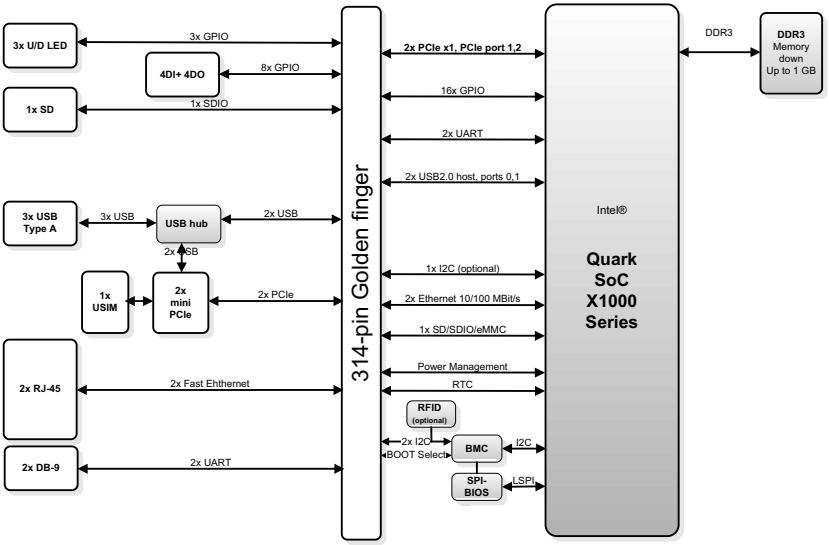

Figure 1-1: MXE-100i Functional Block Diagram

1.4 Unpacking Checklist

Before unpacking, check the shipping carton for any damage. If the shipping carton and/or contents are damaged, inform your dealer immediately. Retain the shipping carton and packing materials for inspection. Obtain authorization from your dealer before returning any product to ADLINK. Ensure that the following items are included in the package.

- MXE-100i unit
- DIN-RAIL/wall-mounting brackets
- Screw pack for DIN-RAIL/wall-mounting and storage fixing
- Quick Start Guide

1.5 Mechanical Drawings

NOTE: All dimensions shown are in millimeters (mm) unless otherwise stated.

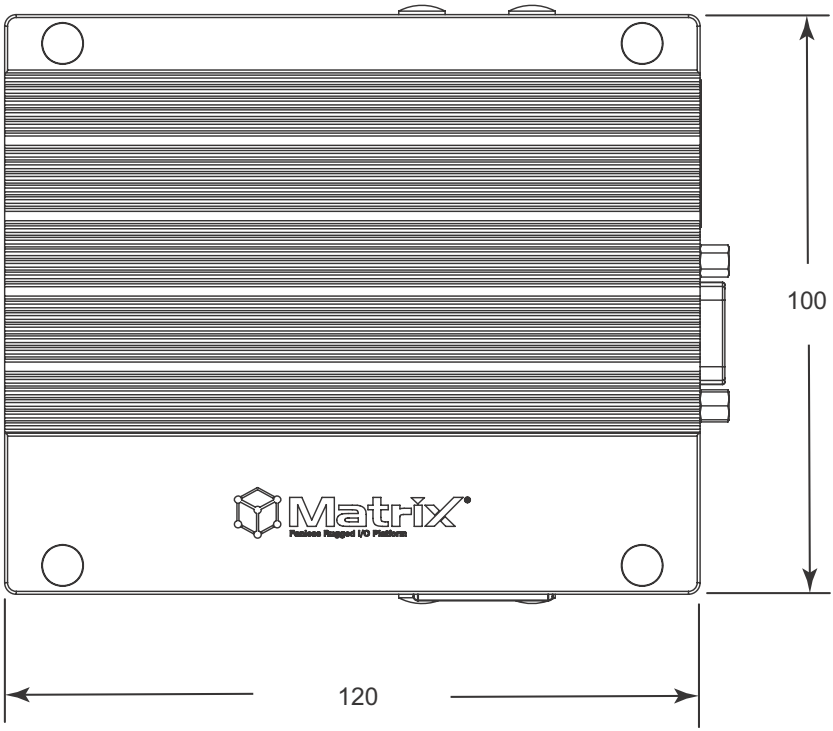

Figure 1-2: Top View

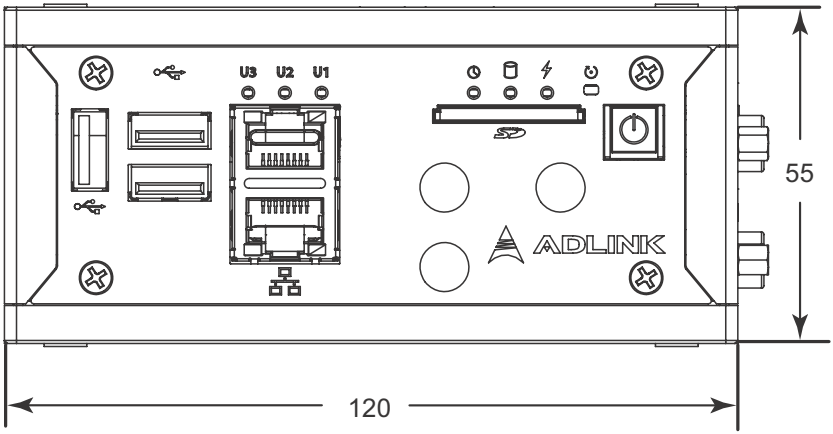

Figure 1-3: Front View

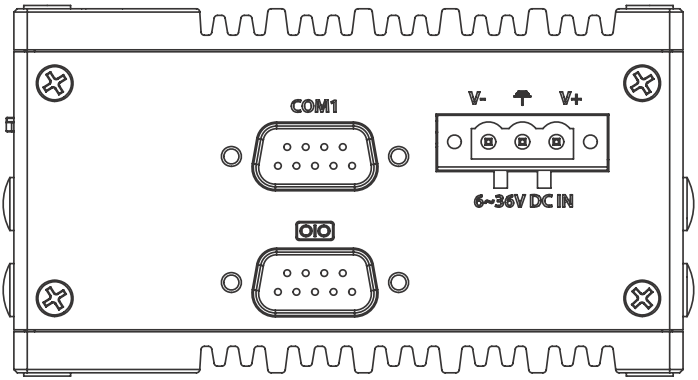

Figure 1-4: (Right) Side View

1.6 Front Panel I/O Connectors

This section describes the I/O connectors located on the front panel of the MXE-100i.

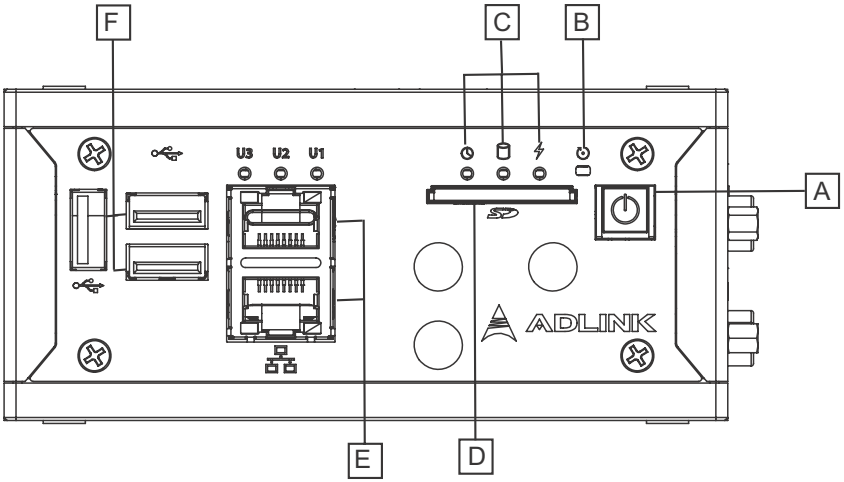

Figure 1-5: Front Panel I/O

A	Power Button	**D**	SD Card
B	Reset Button	**E**	Fast LAN Port x2
C	LED Indicators	**F**	USB 2.0 Port x3

Table 1-1: MXE-100i Front Panel I/O Connector Legend

1.6.1 Power Button

The power button is a non-latched push button with a blue LED indicator. System is turned on when button is pressed, and the power LED lit. If the system hangs, depressing the button for 5 seconds powers down the system.

1.6.2 LED Indicators

In addition to the LED of the power button, three LEDs on the front panel indicate the following operations.

Indicator	Color	Description
Watchdog (WDT)	Yellow	Indicates watchdog timer status. Flashes when watchdog timer starts, and when timer is expired, system will auto-reboots.
Hard disk drive	Orange	When blinking, indicates the SATA hard driver is active
Standby	Blue	Indicates the system is in power standby mode

Table 1-2: LED Indicators

1.6.3 Reset Button

The reset button executes hard reset for the MXE-100i.

1.6.4 Dual Fast Ethernet Ports

The two Fast Ethernet ports on the front panel are based on X1021 MAC and Ti DP83849 PHY.

LED	LED Color	Status	Description
Active/Link	Yellow	OFF	Ethernet port is disconnected
		ON	Ethernet port is connected with no activity
		Flashing	Ethernet port is connected and active
Speed	Green	OFF	10 Mbps
		Green	100 Mbps

Table 1-3: Gigabit Ethernet Port LED Function

1.7 (Right) Side Panel I/O Connectors

This section describes I/O connectors located on the side panel of the MXE-100i.

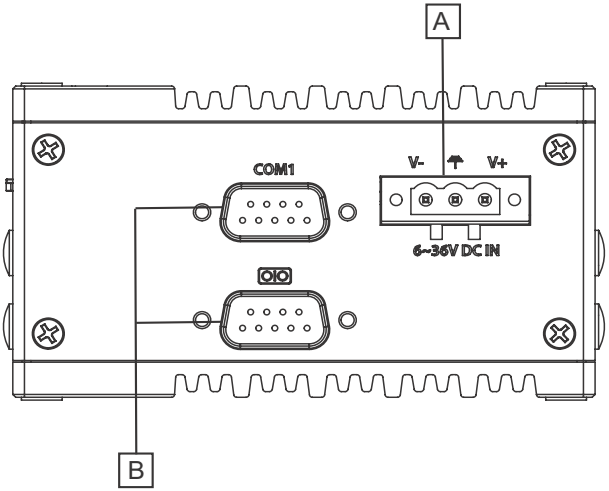

Figure 1-6: (Right) Side Panel I/O

A	DC power supply connector
B	DB-9P COM Ports

Table 1-4: MXE-100i Rear Panel I/O Connector Legend

1.7.1 DB-9P COM Port Connector

2 serial ports connect via DB-9P connectors.

COM1 supports RS-232, and the other selectively supports RS-232/ RS-422/ RS-485 mode by BIOS setting.

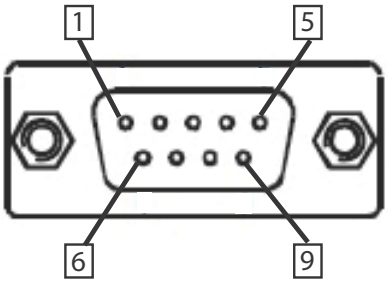

Figure 1-7: DB-9P COM Port

Pin	Signal		
	RS-232	**RS-422**	**RS-485**
1	N/C	TXD422-	485DATA-
2	RXD	TXD422+	485DATA+
3	TXD	RXD422+	N/C
4	N/C	RXD422-	N/C
5	GND	N/C	N/C
6	N/C	N/C	N/C
7	RTS#	N/C	N/C
8	CTS#	N/C	N/C
9	N/C	N/C	N/C

Table 1-5: DB-9P COM Port Pin Assignment

1.8 Internal I/O Connectors

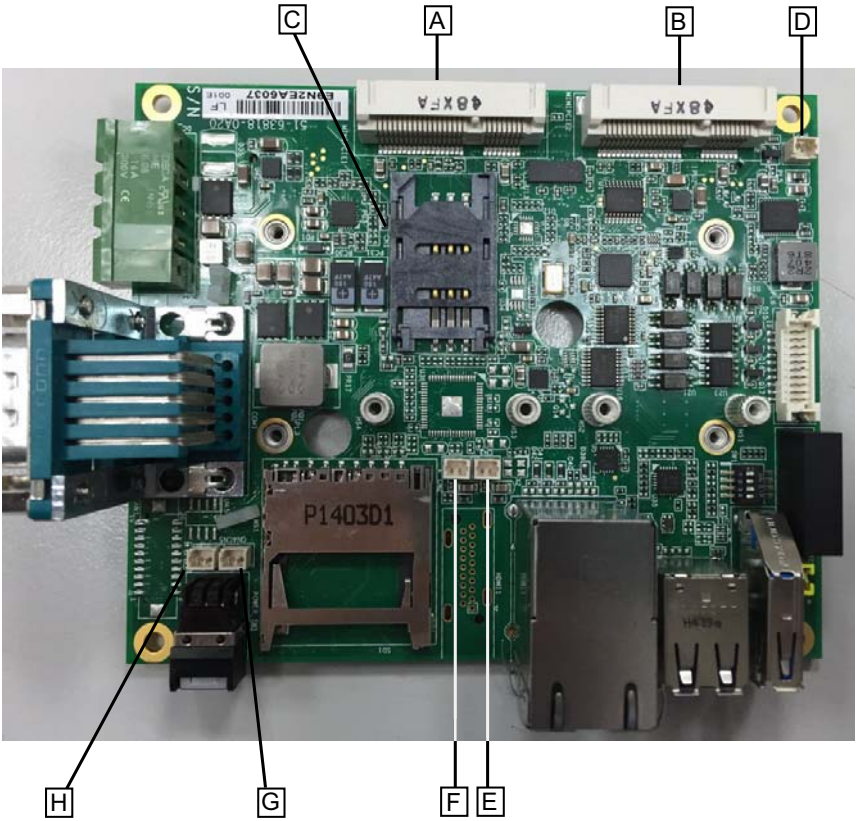

Figure 1-8: Mainboard Top View

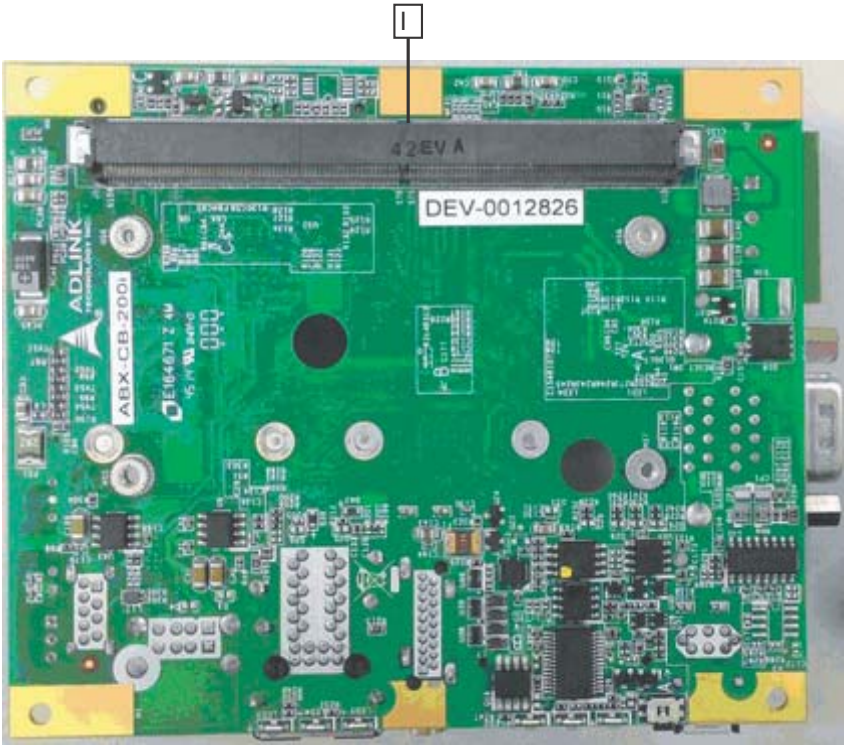

Figure 1-9: Mainboard Underside View

A	Mini-PCIe slot1	**F**	DC 5V connector for GPS module
B	Mini-PCIe slot2	**G**	Extended reset wafer
C	USIM slot	**H**	Extended power wafer
D	RTC battery wafer	**I**	SMARC module slot
E	DC 3.3V connector for GPS module		

Table 1-6: MXE-100i Internal I/O Legend

1.8.1 DC 5V and 3.3V Connectors for GPS Module

The two power connectors, for GPS module use, carry a maximum current rating of 1A each.

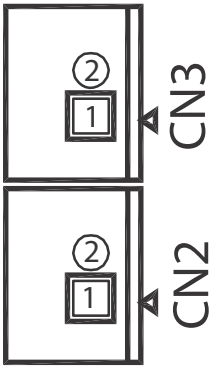

Figure 1-10: DC 5V and 3.3V Connectors Configuration

Pin	Description
CN19	
1	+5V
2	Gnd
CN20	
1	+3.3V
2	Gnd

Table 1-7: DC 5V and 3.3V Connectors Pin Assignments

1.8.2 USIM Port

Use of 3.5G mini-PCIe module requires a SIM card for communication with a telecom operator. The MXE-100i provides a USIM port connected to the mini-PCIe connector, with which a SIM card and 3.5G mini-PCIe module can be installed to facilitate 3.5G communication.

1.8.3 Extendable Power/Reset/LED

The MXE-100i provides internal connectors for the Power button (from CN5) and Reset button (CN4) assigned as shown.

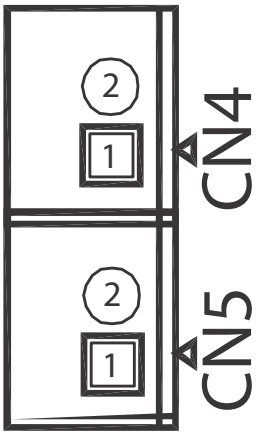

Figure 1-11: Extendable Power/Reset Configuration

Pin	Description
CN4	
1	Reset Button
2	GND
CN5	
1	Power Button
2	GND

Table 1-8: Extendable Power/Reset Connectors Pin Assignments

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2 Getting Started

This chapter discusses installation of a mini-PCI-E module and mSATA. Wall-mount installation is also described.

2.1 Installing a Mini-PCIe Device

Before installing, remove the chassis underside as follows.

1. Remove the 8 screws as shown.

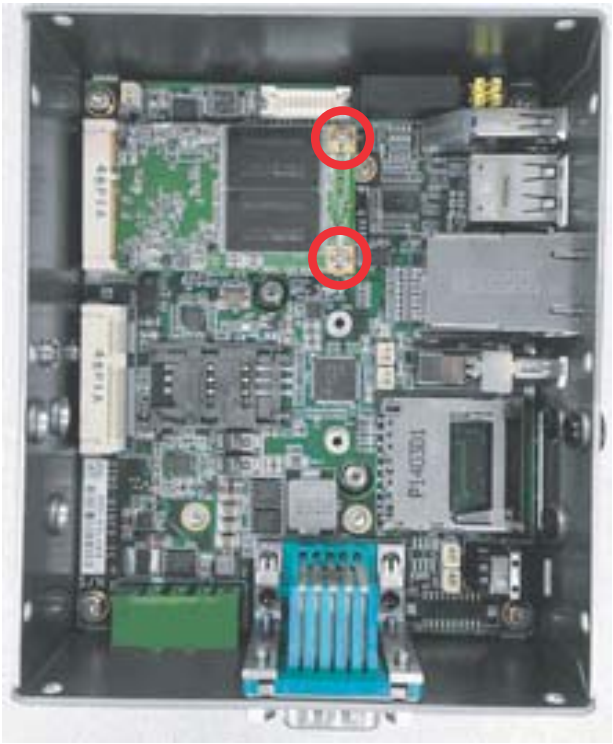
COM1
V-
V+
6V~36V DC IN

Matrix

2. Remove the chassis underside.

3. Insert the mini-PCIE module into the slot at an angle

4. Depress the mini-PCI-E module until seated and fix with two 2 M2.5-P-head-L5 screws.



5. Insert the mini-PCIE wireless module into the slot at an angle.

6. Depress the mini-PCI-E wireless module until seated and fix with two 2 M2.5-P-head-L5 screws.

2.2 Connecting DC power

WARNING:

Before providing DC power to the MXE-100i, ensure the voltage and polarity provided are compatible with the DC input. Improper input voltage and/or polarity can be responsible for system damage.

The DC power input connector of the MXE-100i utilizes V+, V- , and chassis ground pins, and accepts input voltage as shown previously.

1. Connect DC power cables as shown.
2. Fix the DC connector using the 2 screws.

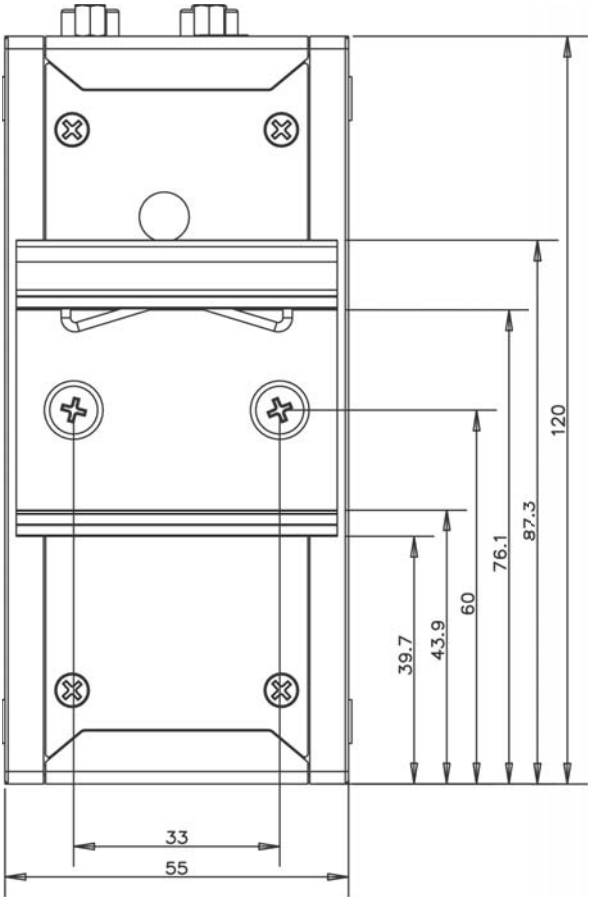
COM1
V-
V+

2.3 DIN-RAIL mounting of the MXE-100i

The MXE-100i controller is shipped with DIN-RAIL mounting brackets and accessory screws, with mounting procedures as follows.

1. Prepare the one DIN-RAIL mount brackets and 2 M4-F head screws included in the package.

2. Use the 2 included M4-F head screws to fix the DIN-RAIL mount brackets to the chassis, according to the spacing dimensions of the screw holes and brackets, as shown.



2.4 Cooling Considerations

Heat-generating components of the MXE-100i (such as CPU and PCH) are all situated on the left side of the system. These components directly contact the heat sink via thermal pads and dissipate heat generated by the components. To maximize efficiency of heat dissipation, maintain a minimum of 2 inches (5 cm) clearance on the top of the MXE-100i.

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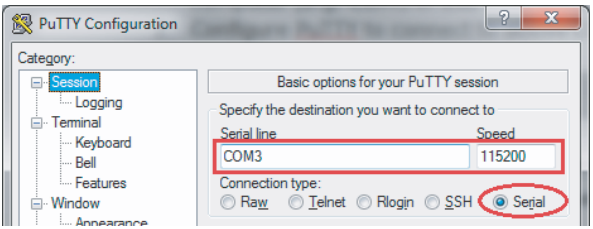
Appendix A Using IDP

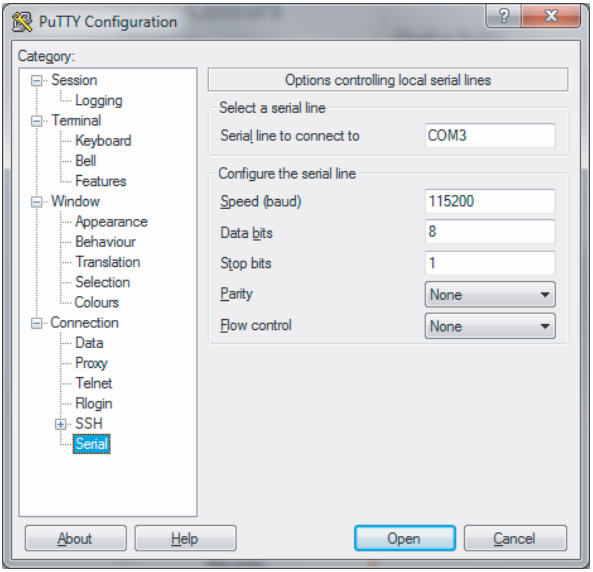
A.1 MXE-100i Setup

The platform is designed for headless operation and does not support keyboard, mouse or video output. Connection must be made remotely using terminal over serial connection (RS232).

NOTE: The following procedure is based on a system on which PuTTY has been installed. PuTTY for Windows is available for download at: http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html

1. Connect the RS-232 console port on the MXE-100i to the host computer with the USB DB-9 to USB adapter. A COM port (COM3 in this example) appears in the host computer's listings as follows.

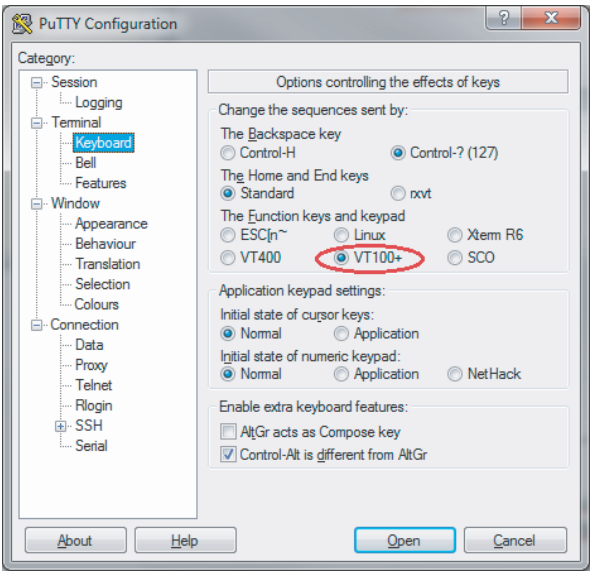




2. Configure PuTTY to connect to the new COM port with settings as follows:

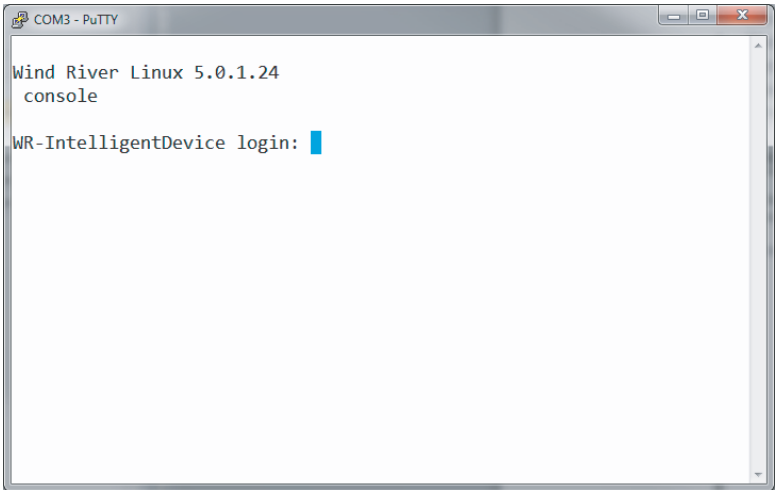
Serial line	COM3 (in this example)
Speed	115200
Data bits	8
Stop bits	1
Parity	None
Flow control	None

3. Configure PuTTY keyboard settings as follows.



4. Attach the AC adaptor plug to the external power supply.
5. Attach the power cable from the adaptor to the MXE-100i. One LED lights on each LAN port.
6. The MXE-100i platform will initiate the boot process, which can be monitored via the PuTTY console on the host computer.

7. Boot will take approximately 2-5 minutes, after which the login screen appears:



8. Log in with:
   Login: root
   Password: root

A.2 MXE-100i Network Connection

The MXE-100i can be connected in various ways.

To the internet or another network

Via WAN port to a router with DHCP server enabled, with the MXE-100i's IP address assigned by the DHCP server.

To a local network

Via LAN port to local computers (with/without hub), with the MXE-100i's IP address 172.31.255.1

To WiFi-enabled devices

WiFi network information is:

SSID: IDPDK-xxxx

Password: windriveridp

MXE-100i's IP address: 192.168.1.1

Where xxxx is the last 4 characters of the MXE-100i WiFi MAC address, which can be found using command:

```
ifconfig wlan0
```

and find for HWaddr. The WiFi SSID in the example shown is IDPDK-cd23.

```
root@WR-IntelligentDevice:~# ifconfig wlan0
wlan0     Link encap:Ethernet  HWaddr 40:e2:30:0d:cd:23
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:157 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:13648 (13.3 KiB)

root@WR-IntelligentDevice:~#
```

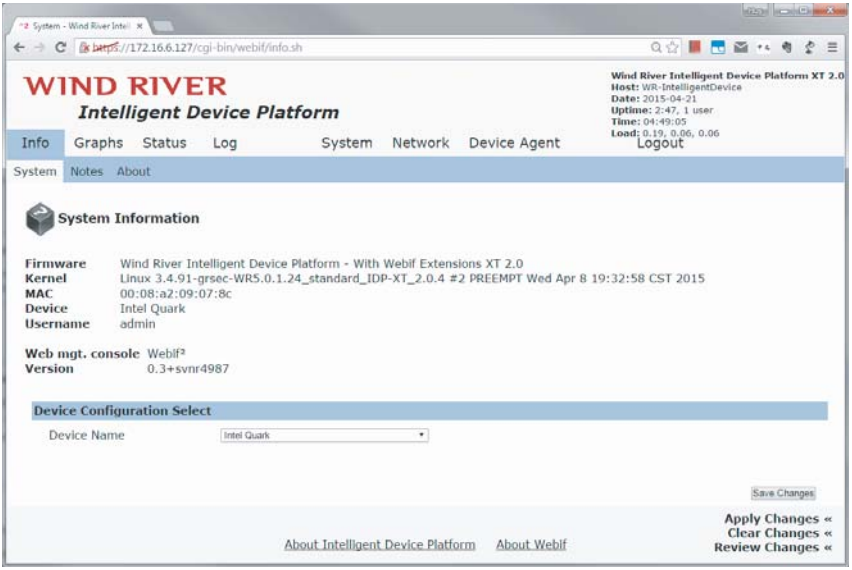
A.3 Wind River Web Interface (webif)

Wind River Systems, Inc. provides a Web Interface tool (webif) allowing many Target System settings to be to controlled and changed.

To access the Web Interface tool:

1. Connect Host System to the same network as the MXE-100i (via WiFi, router, or LAN port as described previously).
2. On the Host System, open an internet browser and go to https://<MXE-100i IP Address>
3. When connection to the Web Interface is successful, user name and password are requested.
4. Login with:
   user name: admin
   password: admin.

A sample webif UI is shown.


https://172.16.6.127/cgi-bin/webif/info.sh
WIND RIVER
Intelligent Device Platform
Wind River Intelligent Device Platform XT 2.0
Host: WR-IntelligentDevice
Date: 2015-04-21
Uptime: 2:47, 1 user
Time: 04:49:05
Load: 0.19, 0.06, 0.06
Info
Graphs
Status
Log
System
Network
Device Agent
Logout
System
Notes
About
System Information
Firmware
Wind River Intelligent Device Platform - With Webif Extensions XT 2.0
Kernel
Linux 3.4.91-grsec-WR5.0.1.24_standard_IDP-XT_2.0.4 #2 PREEMPT Wed Apr 8 19:32:58 CST 2015
MAC
00:08:a2:09:07:8c
Device
Intel Quark
Username
admin
Web mgt. console
Webif²
Version
0.3+svnr4987
Device Configuration Select
Device Name
Intel Quark
Save Changes
Apply Changes «
Clear Changes «
Review Changes «
About Intelligent Device Platform
About Webif

Appendix B Watchdog Timer (WDT) & DI/O Function Libraries

This appendix describes use of the watchdog timer (WDT) function library for the MXE-100i.

The watchdog timer is a hardware mechanism provided to reset the system if the operating system or an application stalls. After starting, the watchdog timer in the application must be periodically reset before the timer expires. Once the watchdog timer expires, a hardware-generated signal is sent to reset the system.

DI/O provides input/output to support inter-device communications. Simple programming guides allow easy transmission of digital signals between the system and attached peripherals.

B.1 WDT with API

To use the WDT function library for MXE-100i series, include the header file matrix_wdt.h and linkage library matrix_wdt.lib in the C++ project.

InitWDT

Initializes watchdog timer function of MXE-100i. InitWDT must be called before the invocation of any other WDT function.

@ Syntax

C/C++

```
BOOL InitWDT()
```

@ Parameters

None

@ Return code

TRUE if watchdog timer is successfully initialized.

FALSE if watchdog timer fails to initialize.

SetWDT

Sets the timeout value of the watchdog timer. There are two parameters for this function to indicate the timeout ticks and unit. ResetWDT or StopWDT should be called before the expiration of watchdog timer, or the system will reset.

@ Syntax

C/C++

```
BOOL SetWDT(BYTE tick, BYTE unit)
```

@ Parameters

`tick`

Specify the number of ticks for watchdog timer. A valid value is 1 - 255.

`unit`

Specify the timeout ticks of the watchdog timer.

Value	Description
0	The unit for one tick is one second. For example, when one tick is specified as 100 and the unit as 0, the timeout value is 100 seconds.
1	The unit for one tick is one minute. For example, whenone tick is specified as 100 and the unit as 1, the timeout value is 100 minutes.

@ Return codes

TRUE if timeout value of watchdog timer is successfully set.

FALSE if timeout value of watchdog timer is failed to set.

StartWDT

Starts watchdog timer function. Once the StartWDT is invoked, the watchdog timer starts. ResetWDT or StopWDT should be called before the expiration of watchdog timer, or the system will reset.

@ Syntax

C/C++

```
BOOL StartWDT()
```

@ **Parameters**

None

@ **Return codes**

TRUE if watchdog timer is successfully started.

FALSE if watchdog timer is failed to start.

ResetWDT

Resets the watchdog timer. The invocation of ResetWDT allows restoration of the watchdog timer to the initial timeout value specified in SetWDT function. ResetWDT or StopWDT should be called before the expiration of the watchdog timer, or the system will reset.

@ **Syntax**

C/C++

```
BOOL ResetWDT()
```

@ **Parameters**

None

@ **Return codes**

TRUE if watchdog timer is successfully reset.

FALSE if watchdog timer fails to reset.

StopWDT

Stops the watchdog timer.

@ **Syntax**

C/C++

```
BOOL StopWDT()
```

@ **Parameters**

None

@ **Return codes**

TRUE if watchdog timer is successfully stopped.

FALSE if watchdog timer fails to stop.

B.2 DI/O with API

To use the DI/O function library for MXE-100i series, include the header file matrix_dio.h and linkage library matrix_dio.lib in the C++ project.

DI/O functions are as follows.

GPIO_Init

Reserves system resources for digital input/output API service.It is necessary to call this function before using other MXE-100i DI/O functions.

@ **Syntax**

C/C++

```
I16 GPIO_Init(void)
```

@ **Parameters**

None

@ **Return code**

```
NoError
ErrorOpenDriverFailed
ErrorDeviceIoctl
```

GPI_Read()

Reads the digital logic state of the digital input line..

@ **Syntax**

C/C++

```
I16 GPI_Read(U16 *pwState)
```

@ **Parameters**

pwState

Returns the digital logic state of MXE-100i digital input channels 1 to 8 (bit 0 to 7)

@ **Return code**

```
NoError
ErrorOpenDriverFailed
ErrorDeviceIoctl
```

GPO_Write()

Sets the digital logic state of the digital output line.

@ Syntax

C/C++

```
I16 GPO_Write(U16 wState)
```

@ Parameters

State

Sets the digital logic state of MXE-100i digital output channels 1 to 8 (bit 0 to 7) to 0 or 1.

@ Return code

```
NoError
ErrorOpenDriverFailed
ErrorDeviceIoctl
```

GPO_Read()

Reads the digital logic state of the digital output line.

@ Syntax

C/C++

```
I16 GPO_Read(U16 *pwState)
```

@ Parameters

pwState

Returns the digital logic state of MXE-100i digital output channels 1 to 8 (bit 0 to 7).

@ Return code

```
NoError
ErrorOpenDriverFailed
ErrorDeviceIoctl
```

Appendix C BIOS Setup

NOTE:

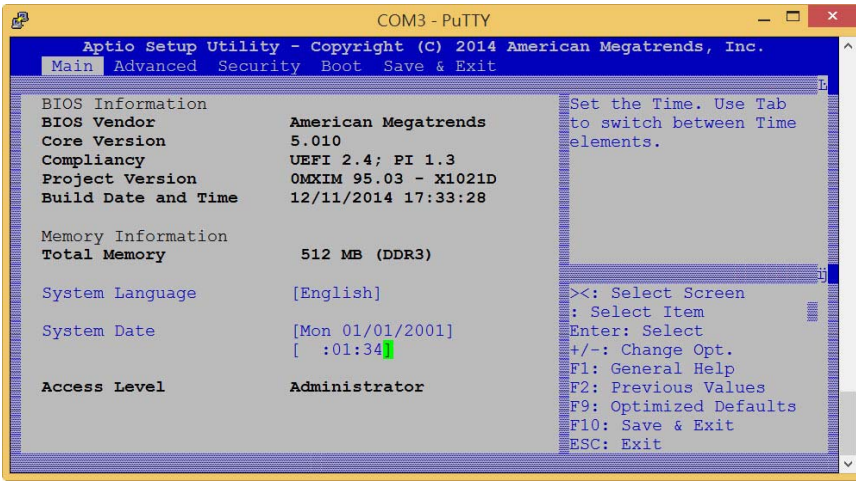
BIOS options in the manual are for reference only, and are subject to configuration. Users are welcome to download the latest BIOS version from the ADLINK website.

The Basic Input/Output System (BIOS) is a program that provides a basic level of communication between the processor and peripherals. In addition, the BIOS also contains codes for various advanced features applied to the MXE-100i. The BIOS setup program includes menus for configuring settings and enabling features of the MXE-100i series. Most users do not need to use the BIOS setup program, as the MXE-100i ships with default settings that work well for most configurations.

WARNING:

Changing BIOS settings may lead to incorrect controller behavior and possible inability to boot.

C.1 Main



C.1.1 BIOS Information

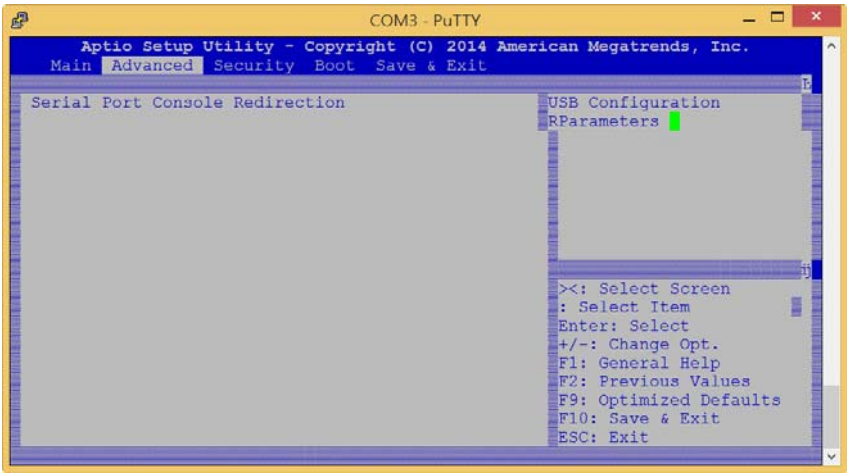
Shows current system BIOS core version, BIOS version and Board version.

C.1.2 System Time/System Date

Changes system time and date. Highlight System Time or System Date using the up or down <Arrow> keys. Enter new values using the keyboard then <Enter>. Use < Tab > to move between fields. The date must be entered in MM/DD/YY format. The time is entered in HH:MM:SS format.

NOTE: The time is in 24-hour format, for example, 5:30 A.M. appears as 05:30:00, and 5:30 P.M. as 17:30:00.

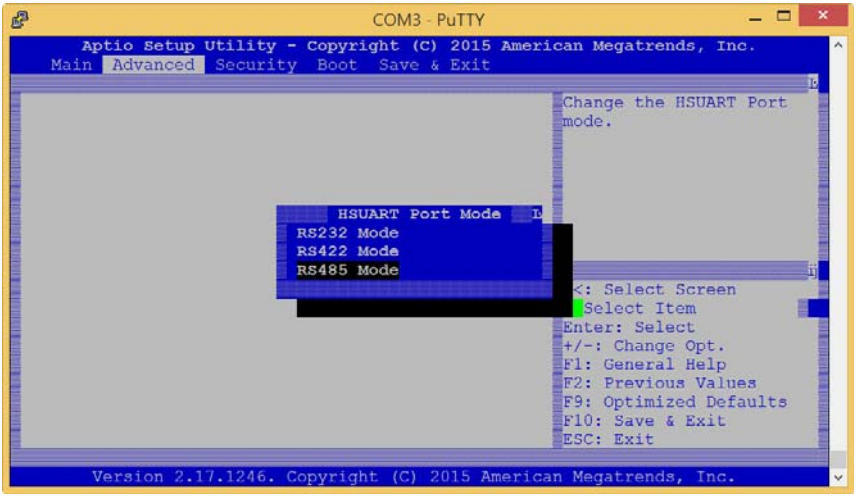
C.2 Advanced



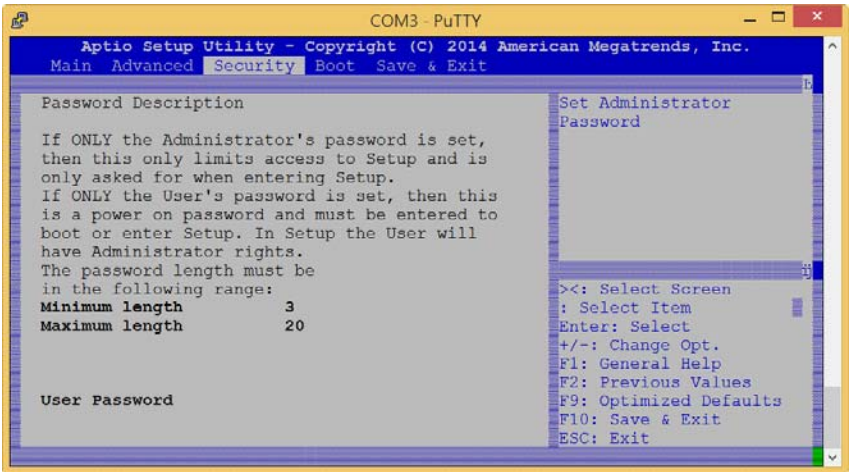
CAUTION:

Setting incorrect or conflicting values in Advanced BIOS Setup may cause system malfunction.

C.2.1 COM Port Settings



C.3 Security



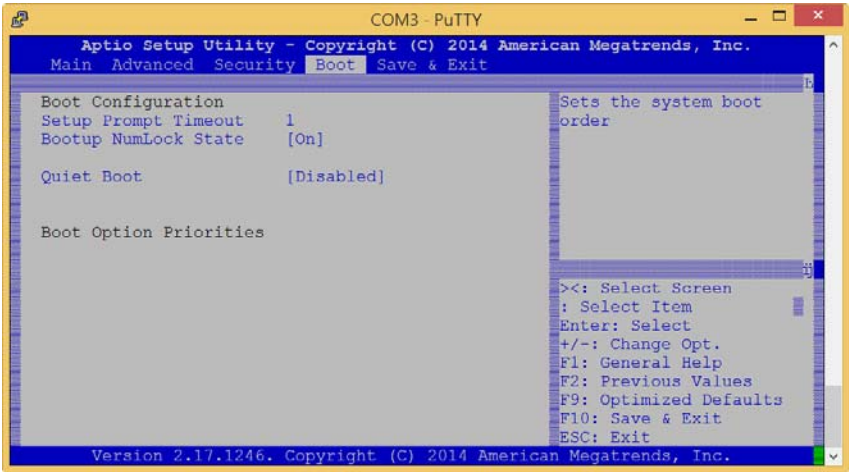
NOTE:

If only the Administrator's password is set, only access to Setup is limited and authorization requested only when entering Setup. If only the User's password is set, a password must be entered to boot or enter setup. In Setup the user has Administrator rights.

User Password

Sets boot/setup User password.

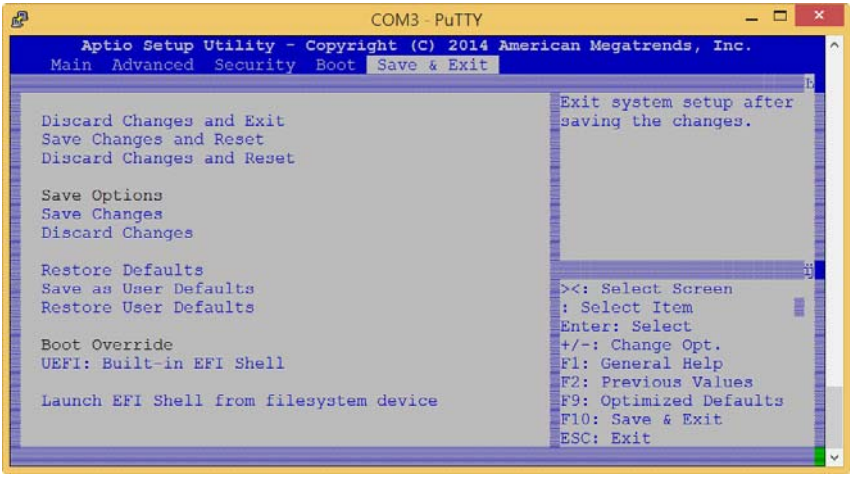
C.4 Boot



Boot Option Priorities

Specifies the priority of boot devices, with all installed boot devices detected during POST and displayed, where selecting Boot Option # specifies the desired boot device.

C.5 Exit



Save Changes and Exit

Exits Setup after saving changes.

Discard Changes and Exit

Exits Setup without saving any changes.

Save Changes and Reset

Resets the system after saving changes.

Discard Changes and Reset

Resets system setup without saving any changes.

Save Changes

Saves all changes made to Setup options.

Discard Changes

Discards changes made to Setup options.

Restore Defaults

Returns all BIOS options to Default settings, providing maximum system stability with limited performance. Applicable in the event of system configuration problems.

Save as User Defaults

Save changes as User Defaults.

Restore User Defaults

Restores User Defaults to all Setup options.

Launch EFI Shell from filesystem device

Initiates launch of EFI Shell application (Shellx64.efi) from an available filesystem device.

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Important Safety Instructions

For user safety, please read and follow all **instructions**, **WARNINGS**, **CAUTIONS,** and **NOTES** marked in this manual and on the associated equipment before handling/operating the equipment.

- Read these safety instructions carefully.
- Keep this user's manual for future reference.
- Read the specifications section of this manual for detailed information on the operating environment of this equipment.
- When installing/mounting or uninstalling/removing equipment:
  - Turn off power and unplug any power cords/cables.
- To avoid electrical shock and/or damage to equipment:
  - Keep equipment away from water or liquid sources;
  - Keep equipment away from high heat or high humidity;
  - Keep equipment properly ventilated (do not block or cover ventilation openings);
  - Make sure to use recommended voltage and power source settings;
  - Always install and operate equipment near an easily accessible electrical socket-outlet;
  - Secure the power cord (do not place any object on/over the power cord);
  - Only install/attach and operate equipment on stable surfaces and/or recommended mountings; and,
  - If the equipment will not be used for long periods of time, turn off and unplug the equipment from its power source.

- Never attempt to fix the equipment. Equipment should only be serviced by qualified personnel.
- A Lithium-type battery may be provided for uninterrupted, backup or emergency power.

WARNING:

Risk of explosion if battery is replaced with an incorrect type; please dispose of used batteries appropriately.

- Equipment must be serviced by authorized technicians when:
  - The power cord or plug is damaged;
  - Liquid has penetrated the equipment;
  - It has been exposed to high humidity/moisture;
  - It is not functioning or does not function according to the user's manual;
  - It has been dropped and/or damaged; and/or,
  - It has an obvious sign of breakage.

Please pay strict attention to all warnings and advisories appearing on the device, to avoid injury or damage.

Getting Service

Contact us should you require any service or assistance.

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