Rugged Substation Automation Edge Controller

Version:
v1.0.0

Date:
18.08.2025

Contents

1 Copyright

2 Regulatory Compliances

2.1 CE and UKCA Notice

This device complies with the requirements of the CE directive and UKCA regulations.

Low Voltage Directive 2014/35/EU + Electrical Equipment Safety Regulations 2016 (SI 2016 No 1101)

- IEC 62368-1: 2014
- EN 62368-1: 2014/A11: 2017

EMC Directive 2014/30/EU + Electromagnetic Compatibility Regulations 2016

- EN 55032: 2015+AC: 2016 (Class A)
- BS EN 55032: 2015+AC: 2016 (Class A)
- CISPR 32: 2015+COR1: 2016 (Class A)
- AS/NZS CISPR 32: 2015 (Class A)
- EN 55024: 2010+A1: 2015
- BS EN 55024: 2014+A1: 2015
- CISPR 24: 2010+A1: 2015
- EN 55035: 2017
- BS EN 55035: 2017
- CISPR 35: 2016

RoHS 2 Directive 2011/65/EU & 2015/863/EU + RoHS 2 Directive 2020 No. 1647

- Exemption(s) used:
- 6c,7a,7c-I

2.2 FCC PART 15 VERIFICATION STATEMENT

WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Notice: The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

3 Safety Instructions

Please read these safety instructions carefully and retain them for future reference.

3.1 General Safety Guidelines

1. Keep the chassis area clean and dust-free before, during, and after installation.
2. Do not wear loose clothing or jewelry when working around the chassis. Secure ties, scarves, and roll up sleeves.
3. Wear safety glasses when working in conditions that may pose a risk to your eyes.
4. Always disconnect power before installing or removing a chassis or working near power supplies. Turn off the power and unplug the power cord.
5. Do not work alone in potentially hazardous conditions.
6. Never assume that power is off—always check the circuit before beginning work.

3.2 Lithium Battery Caution

1. **Risk of Explosion:** Use only the recommended battery type. Dispose of used batteries according to local regulations.
2. Installation should only be performed by qualified personnel familiar with relevant device specifications.
3. Do not lift or carry the power supply by its handle.
4. Do not dispose of batteries in fire or expose them to high temperatures or mechanical damage.
5. Batteries exposed to extreme heat or low air pressure may explode or leak flammable gases or liquids.

3.3 Operating Safety

1. Ensure the operating environment has adequate air circulation. Electrical equipment generates heat and requires proper ventilation.
2. Always secure the chassis cover to maintain proper airflow.
3. Protect sensitive components from electrostatic discharge (ESD).
4. Use an ESD wrist strap that makes direct contact with your skin. If unavailable, ground yourself by touching the metal part of the chassis.
5. Check the resistance of your antistatic strap periodically—it should be between 1 and 10 megohms (MΩ).

3.4 Mounting and Installation Precautions

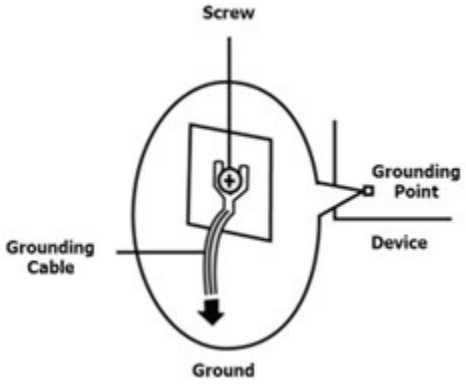
1. Do not install or operate the equipment near flammable materials.
2. In rack-mounted setups, ensure ambient temperature does not exceed the unit's maximum rated temperature.
3. Maintain unobstructed intake and exhaust ventilation to ensure safe airflow.
4. Ensure even mechanical loading when mounting to prevent hazardous conditions.
5. Avoid overloading supply circuits; check nameplate ratings for reference.
6. Ensure reliable grounding, especially when using power strips or indirect connections.

3.5 Installation & Operation

1. This equipment must be installed by trained specialists only. Improper installation can lead to falls, damage, or injury.
2. Welotec GmbH shall not be liable for damages due to insufficient mounting strength or inappropriate components.

3.6 Electrical Safety Instructions

1. Before powering on the device, properly ground it using a grounding cable.
2. Grounding is essential to reduce risks from external electrical noise and lightning.
3. When uninstalling the equipment, turn off the power and then disconnect the ground wire.
4. The ground wire must be a minimum of 4 mm^2 (10 AWG).
5. Use only a 30 A protection device for DC power, connected before the power input.
6. This equipment is suitable for restricted access areas and IT rooms per NEC Article 645 and NFPA 75.



4 Product Specifications

4.1 Technical Details

Feature	Specification	Details
Processor	CPU	Intel® Atom® x7-E3950 (Apollo Lake), 4 Cores, 1.6 GHz (up to 2.0 GHz), 2 MB L2 Cache
	Generation	Apollo Lake
Security	TPM	TPM 2.0 (Trusted Platform Module) for secure device provisioning and authentication
Memory	System Memory	8 GB DDR3L RAM (1866 MHz)
Graphics	GPU	Intel® HD 505 Graphics Controller
Display	Display Interfaces	1 × HDMI (max 1920 × 1200 @ 60 Hz)
Storage	Storage Capacity	128 GB 3D-TLC SSD (wide temperature); optional RAID Level 1
Networking	Ethernet	5 × RJ45 (10/100/1000 Mbps), 2 × SFP (10/100/1000 Mbps), Intel® I210-IT, Ports 1 & 2 with bypass feature
Expansion	USB Ports	2 × USB 3.0 Type A
	Serial Ports	2 × RS-232 (DB9 with isolation)
Operating System	OS Support	Windows 10 Pro / IoT Enterprise 2016 LTSB / 2019 LTSC, Linux Ubuntu (Kernel 4.x), VxWorks
Software Features	Application Deployment	AWS IoT Greengrass Supported
	Cloud Compatibility	AWS IoT Greengrass Certified
	Security Features	TPM 2.0, Secure Boot, ESD isolated serial ports, LAN Bypass
	Network Features	LAN Bypass on Ports 1 & 2
Power	Power Input	20–54 V DC
Mechanical	Mounting	DIN Rail / Wall Mount
	Dimensions	65 mm (W) × 186 mm (H) × 160 mm (D)
	Weight	1600 g
Environmental	Operating Temperature	–40°C to +75°C
	Storage Temperature	–40°C to +85°C
	Operating Humidity	5% to 95% @ 40°C (non-condensing)
Certifications	Compliance	CE, RoHS, REACH, IEC 61850-3, IEEE 1613

5 Power Supply

Use the terminal block to connect the RSAEC to a 20-54V DC power source.

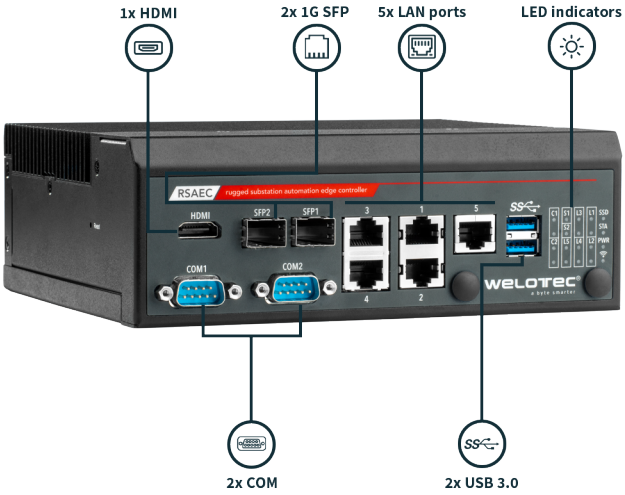
Input Power Connector: Dual DC Input

Pin	Function
1	DC2+
2	DC2–
3	ALARM1
4	ALARM2
5	DC1+
6	DC1–

Note: If either DC1 or DC2 fails, both ALARM1 and ALARM2 will short-circuit to signal the failure.

6 Interfaces and Connections

6.1 Front Panel Overview



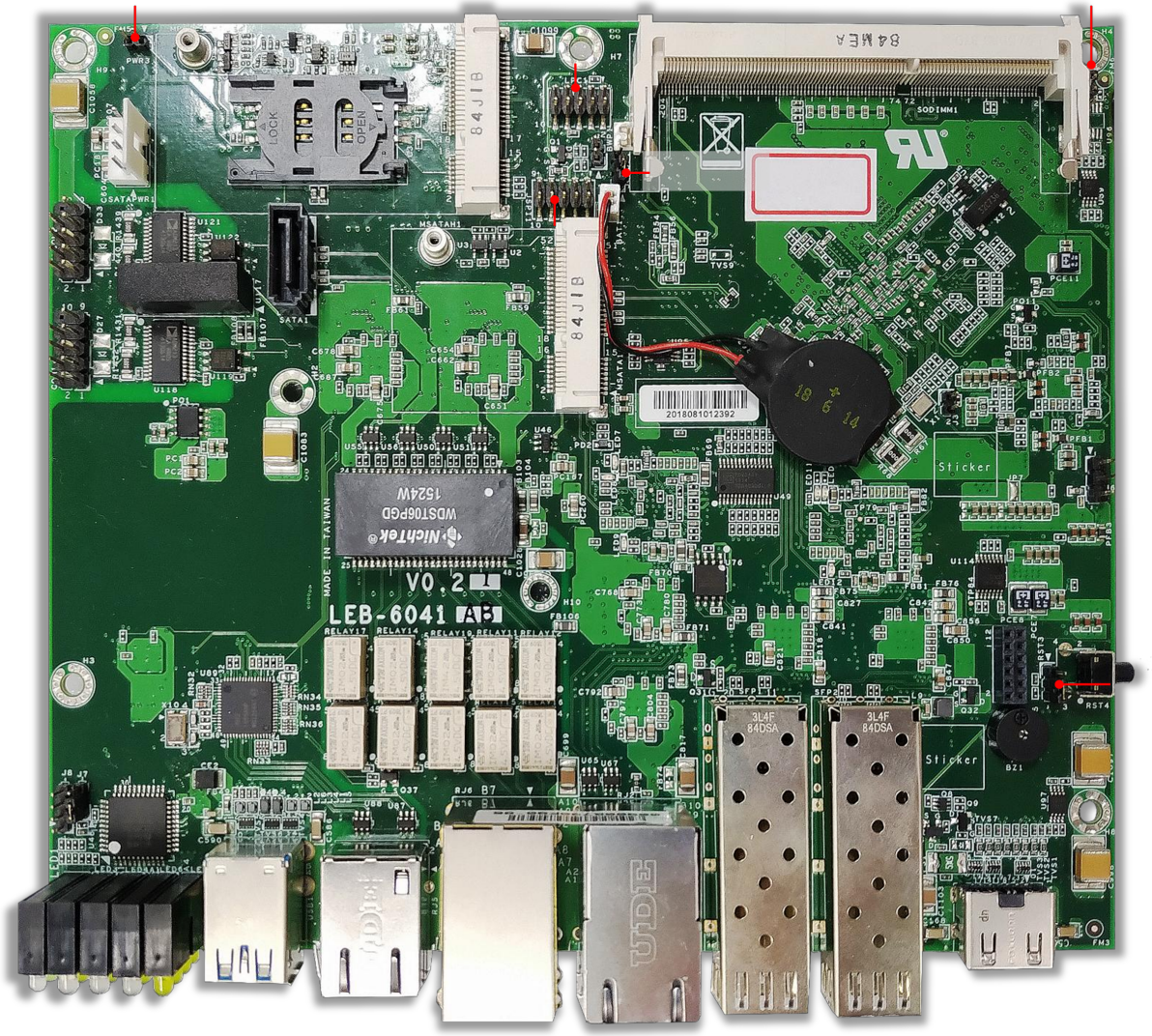
Refer to Appendix A for LED indicator behavior and signal explanations.

6.2 Rear Panel Overview

7 DIP Switch Settings and Pin Definitions

7.1 Motherboard Layout

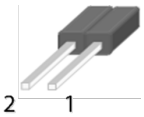
Connector and jumper positions are shown below for reference.



7.2 Internal Jumpers & Connectors

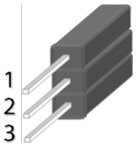
7.2.1 Power Button (PWR3)

Jumper	Function
1–2	Power ON/OFF System
NC (Default)	Normal Operation



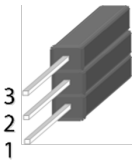
7.2.2 HW/SW Reset Selection

Jumper	Function
1–2	Software Reset
2–3 (Default)	Hardware Reset



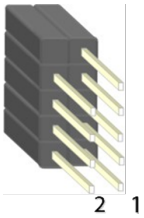
7.2.3 Clear CMOS (JCMOS1/2)

Jumper	Function
1–2 (Default)	Normal Operation
2–3	Clear CMOS



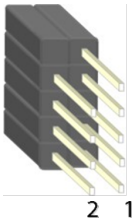
7.3 Connector Pin Assignments

7.3.1 COM1: Serial Port 1



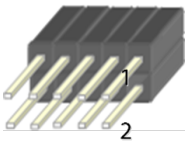
Pin	Function	Pin	Function
1	NC	2	NC
3	COM1_R_RXD	4	NC
5	COM1_R_TXD	6	NC
7	NC	8	NC
9	COM1_2_GND		

7.3.2 COM2: Serial Port 2



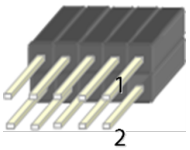
Identical layout and functions as COM1.

7.3.3 JSPI1: SPI ROM Connector (for RD Debug)



Pin	Function	Pin	Function
1	HOLD#	2	NC
3	CS#	4	+1.8V
5	MISO	6	NC
7	NC	8	CLK
9	GND	10	MOSI

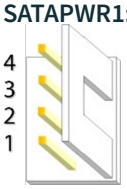
7.3.4 LPC1: LPC Connector (for RD Debug)



Pin	Function	Pin	Function
1	CLK_24M_P80	2	L_AD1
3	PLTRST_P80_N	4	L_AD0
5	L_FRAME_N	6	P3V3S
7	L_AD3	8	GND
9	L_AD2	10	GND

7.3.5 SATA & mSATA Connectors

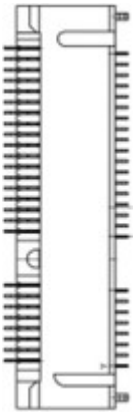
SATAPWR1: SATA Power Connector



Pin	Function
1	V12_S
2	GND
3	GND
4	V5_S

SATA1: SATA Data Connector

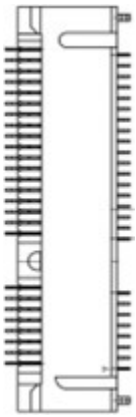
Pin	Function	Pin	Function
1	GND	5	SATA_RXN1_C
2	SATA_TXP1_C	6	SATA_RXP1_C
3	SATA_TXN1_C	7	GND
4	GND		



MSATA1: mSATA Connector

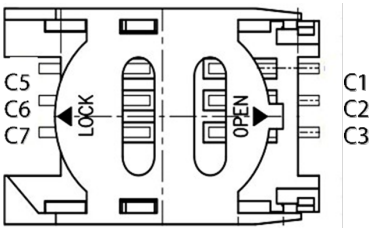
Pin	Function	Pin	Function
1	NC	2	V3P3_S
3	NC	4	GND
5	NC	6	NC
7	NC	8	NC
9	GND	10	NC
11	NC	12	NC
13	NC	14	NC
15	GND	16	NC
17	NC	18	GND
19	NC	20	NC
21	GND	22	NC
23	SATA_RXP0_C	24	V3P3_S
25	SATA_RXN0_C	26	GND
27	GND	28	NC
29	GND	30	NC
31	SATA_TXN0_C	32	NC
33	SATA_TXP0_C	34	GND
35	GND	36	NC
37	GND	38	NC
39	V3P3_S	40	GND
41	V3P3_S	42	NC
43	GND	44	NC
45	NC	46	NC
47	NC	48	NC
49	NC	50	GND
51	NC	52	V3P3_S

7.4 MPCIE1: Mini-PCIe Connector



Pin	Function	Pin	Function
1	WAKE#	2	V3P3_S
3	NC	4	GND
5	NC	6	V1P5_S
7	CLKREQ#	8	UIM_PWR
9	GND	10	UIM_DATA
11	CLK_MPCIE_DN	12	UIM_CLK
13	CLK_MPCIE_DP	14	UIM_RESET
15	GND	16	NC
17	NC	18	GND
19	NC	20	W_DISABLE#
21	GND	22	PERST#
23	MPCIE_RXN	24	V3P3_S
25	MPCIE_RXP	26	GND
27	GND	28	V1P5_S
29	GND	30	NC
31	MPCIE_TXN	32	NC
33	MPCIE_TXP	34	GND
35	GND	36	USB2_DN4
37	GND	38	USB2_DP4
39	V3P3_S	40	GND
41	V3P3_S	42	LED_WWAN#
43	GND	44	LED_WLAN#
45	NC	46	NC
47	NC	48	V1P5_S
49	NC	50	GND
51	NC	52	V3P3_S

7.5 SIM1: SIM Card Socket

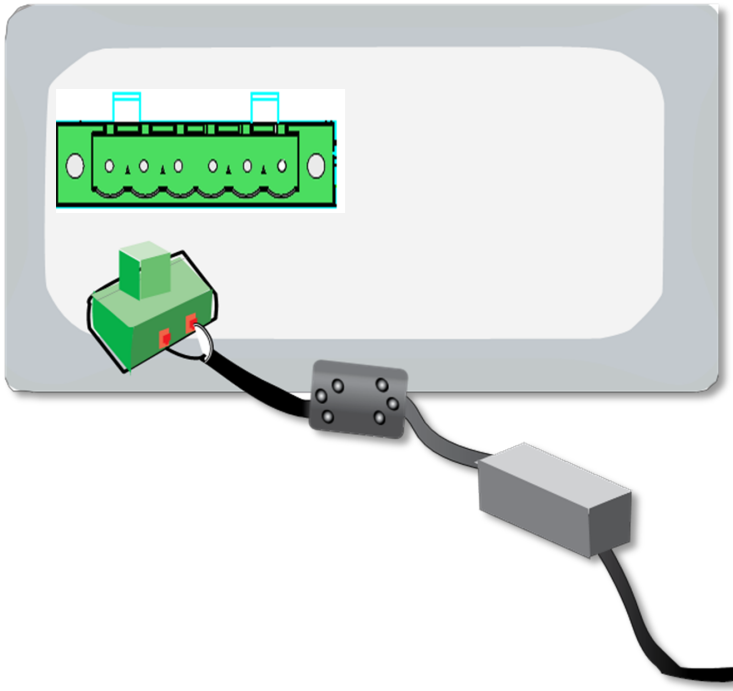


Pin	Function
C1	UIM_PWR
C2	UIM_RST#
C3	UIM_CLK
C5	GND
C6	NC
C7	UIM_DATA

8 Hardware Installation

8.1 Power Connection

To power the device, connect it to a **20–54 VDC** power source via the included **Phoenix Contact terminal block**. This power interface is designed to prevent electrical damage due to reverse polarity—ensuring system safety even if the positive and negative terminals are inadvertently reversed.



1x Phoenix

⚠ Note:
If either power input (DC1 or DC2) fails, both ALARM1 and ALARM2 will be triggered via short-circuit to indicate a fault.

8.2 Wall Mounting

The device can be mounted on a wall using the **DIN Rail Bracket**:

1. Attach the DIN rail bracket to the rear of the chassis using three screws.
2. Hook the bracket onto the DIN rail and press down until the device is securely fixed.

8.3 Rack Mounting

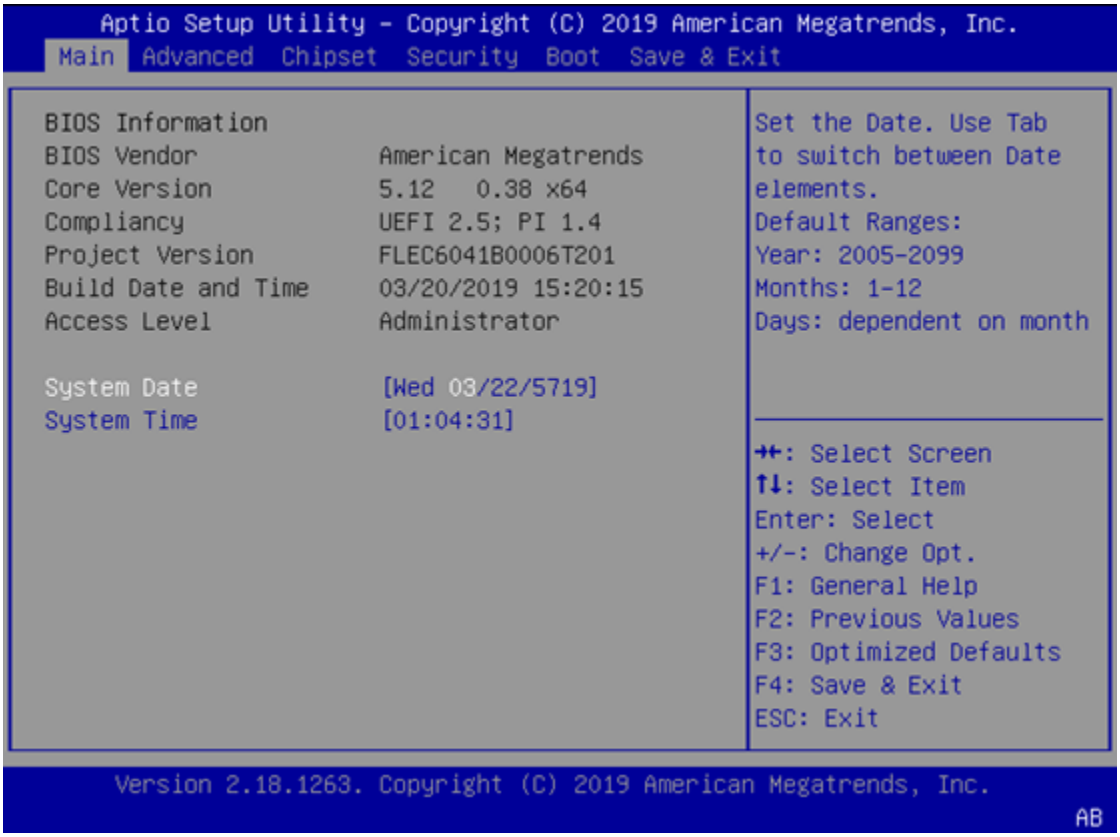
Using the **short ear brackets** included in the Ear Bracket Accessory Pack, the device can be installed in a standard desktop or adjustable rack.

1. Remove the screws (as indicated) from both sides of the device, and secure the ear brackets using the provided **black mounting screws**.
2. Position the device with its rear facing you, and carefully slide it into the rack. Secure the brackets to the rack posts using standard **rack-mount screws** and/or **retainer nuts**.

9 BIOS Setup

This chapter provides an overview of the BIOS interface and detailed instructions on how to configure system settings, including security, boot options, device management, and hardware monitoring.

9.1 Main Page



9.1.1 System Information

Displays essential BIOS and system data:

- **BIOS Vendor:** American Megatrends
- **Core Version:** AMI Kernel version, CRB code base, X64
- **Compliancy:** UEFI version, PI version
- **Project Version:** BIOS release version
- **Build Date and Time:** MM/DD/YYYY
- **Access Level:** Administrator / User

9.1.2 System Date & Time

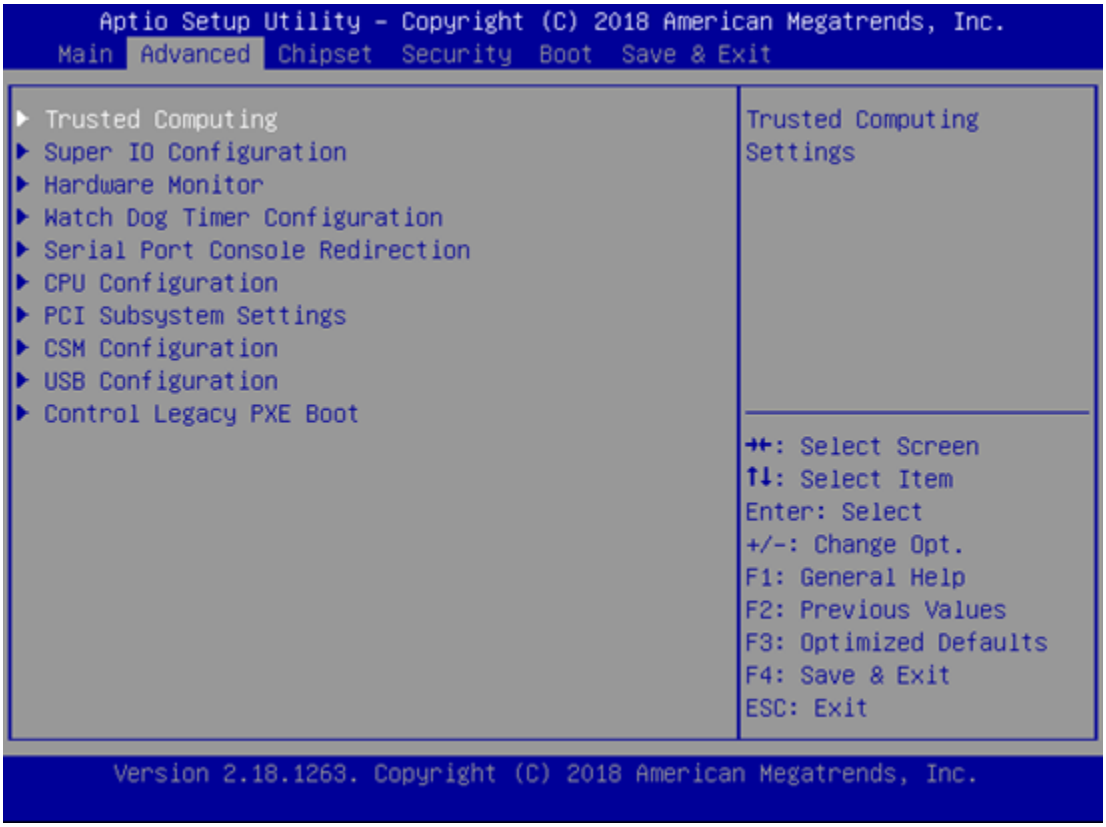
Configure the system clock:

- **System Date:** Use to switch between year (2005–2099), month (1–12), and day (1–31 depending on month)
- **System Time:** Format [hh:mm:ss]; use to navigate fields

9.1.3 BIOS Navigation Keys

Key	Function
→ ←	Switch setup screen
↑ ↓	Select item/option
	Confirm selection or enter submenu
+/-	Change value
F1	Help screen
F2	Retrieve previous values
F3	Load optimized defaults
F4	Save and exit
	Exit current menu

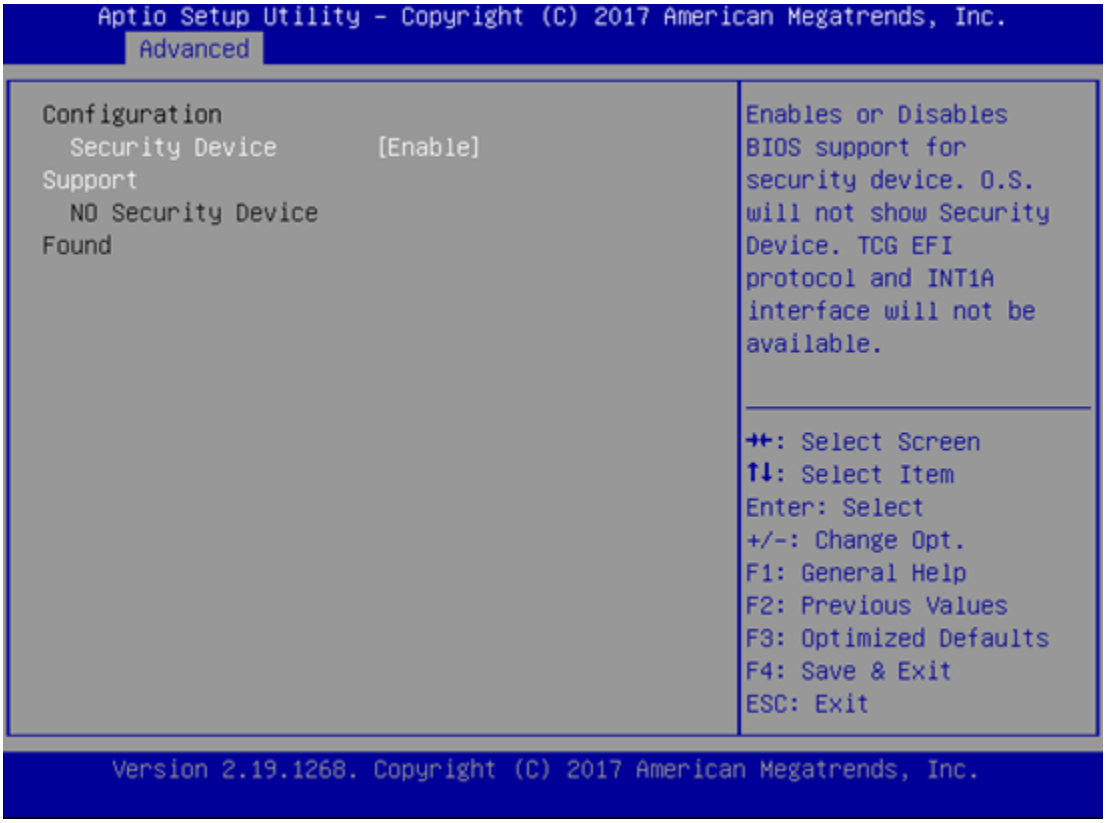
9.2 Advanced Page



Provides access to deeper system-level configuration. Key areas include:

- **Trusted Computing**
- **Super IO Configuration**
- **Hardware Monitor**
- **Watchdog Timer**
- **Serial Console Redirection**
- **CPU Configuration**
- **PCI Subsystem Settings**
- **CSM and USB Configuration**
- **Legacy PXE Boot Control**

9.2.1 Trusted Computing



Manage TPM settings, including support, device selection, hierarchy options, and version configurations for TPM 1.2 and TPM 2.0.

9.2.2 Super IO Configuration

Set parameters for Serial Ports (COM1/COM2):

- **Enable/Disable ports**
- **I/O Address and IRQ display**
- **Mode: RS232**

9.2.3 Hardware Monitor

Displays real-time sensor data:

- **CPU Temp**
- **System Temp**
- **CPU VCORE**
- **VSB5V, VBAT, 3.3V**

9.2.4 Watchdog Timer

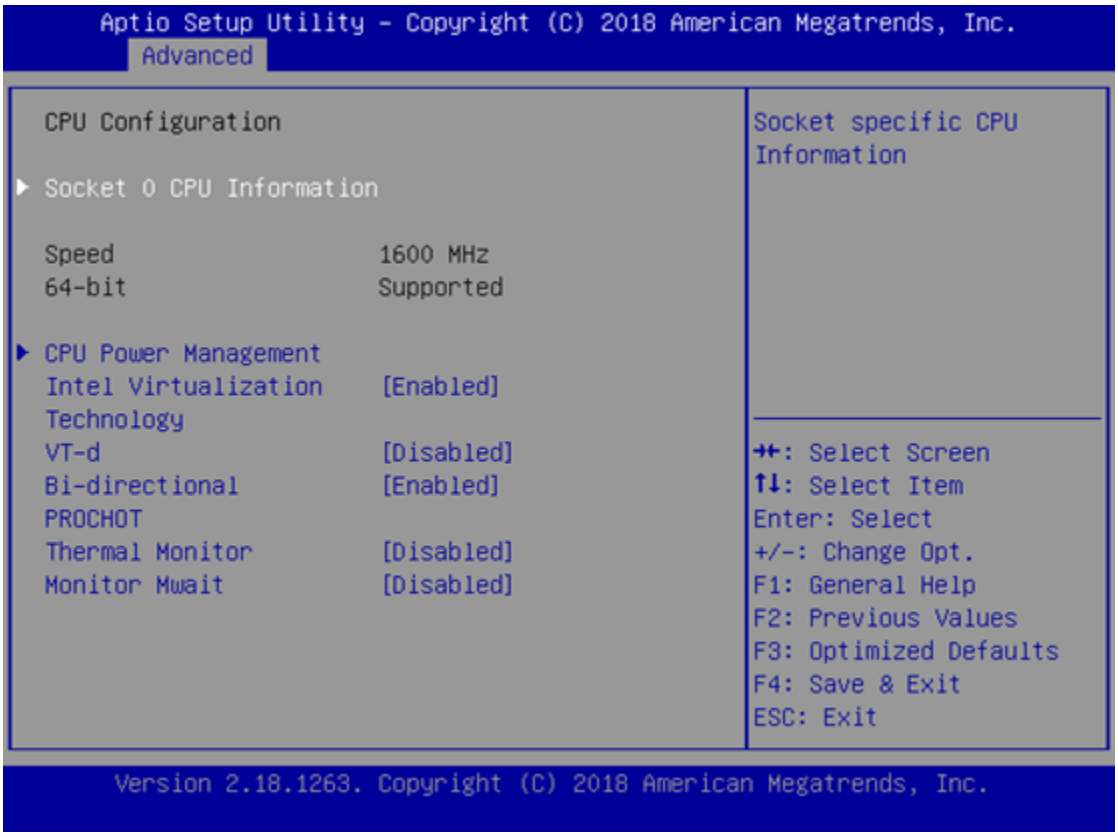
- **Enable/Disable system reset functionality** for fault tolerance

9.2.5 Serial Console Redirection

Configure COM0 for remote access:

- **Enable/Disable redirection**
- **Terminal type, baud rate, parity, stop bits**
- **VT-UTF8 and resolution options**

9.2.6 CPU Configuration



- **Intel Virtualization Technology, VT-d**
- **PROCHOT and Thermal Monitor controls**
- **Monitor/Mwait toggles**

9.2.7 PCI Subsystem Settings

- **Above 4G Decoding:** Enables support for 64-bit PCI
- **Hot-Plug Support:** Configure system-wide hot-plug behavior

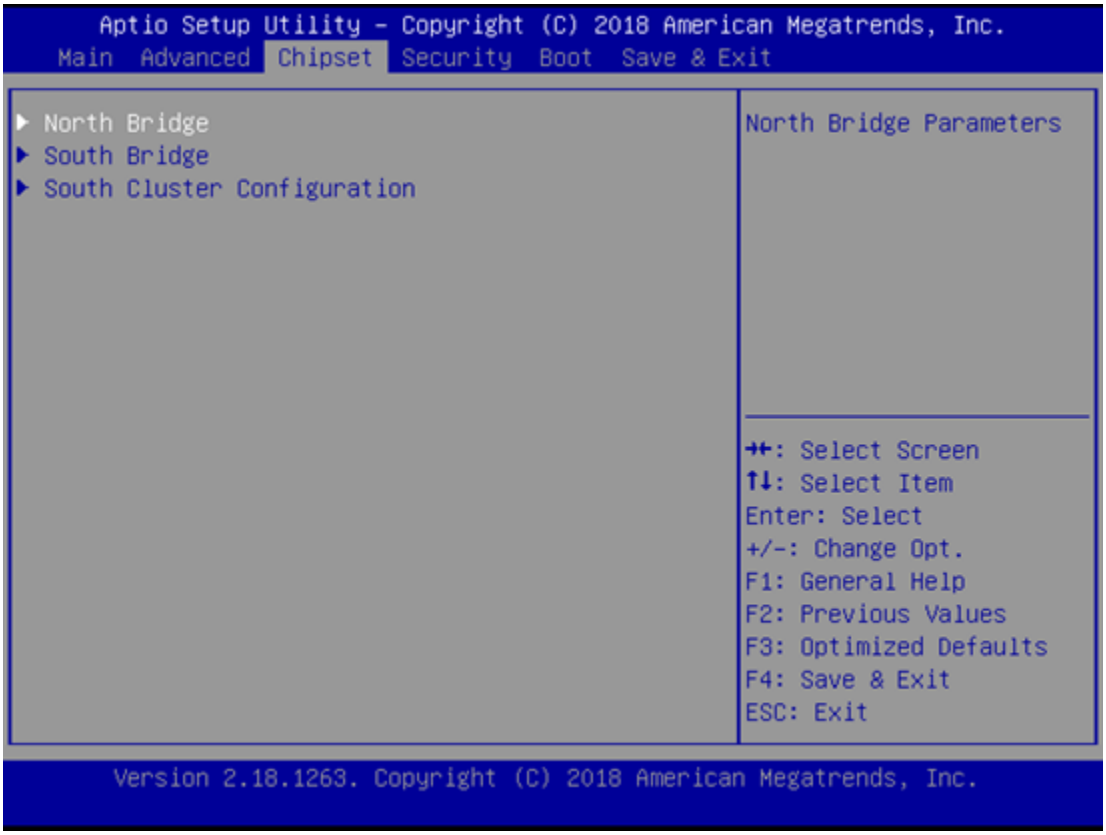
9.2.8 CSM & USB Configuration

- **CSM Support** and individual device boot policies (Network, Storage, Video)
- **Legacy USB, XHCI hand-off, storage driver timeouts**

9.2.9 Control Legacy PXE Boot

- Configure boot behavior via LAN1 or LAN2 interfaces

9.3 Chipset Configuration



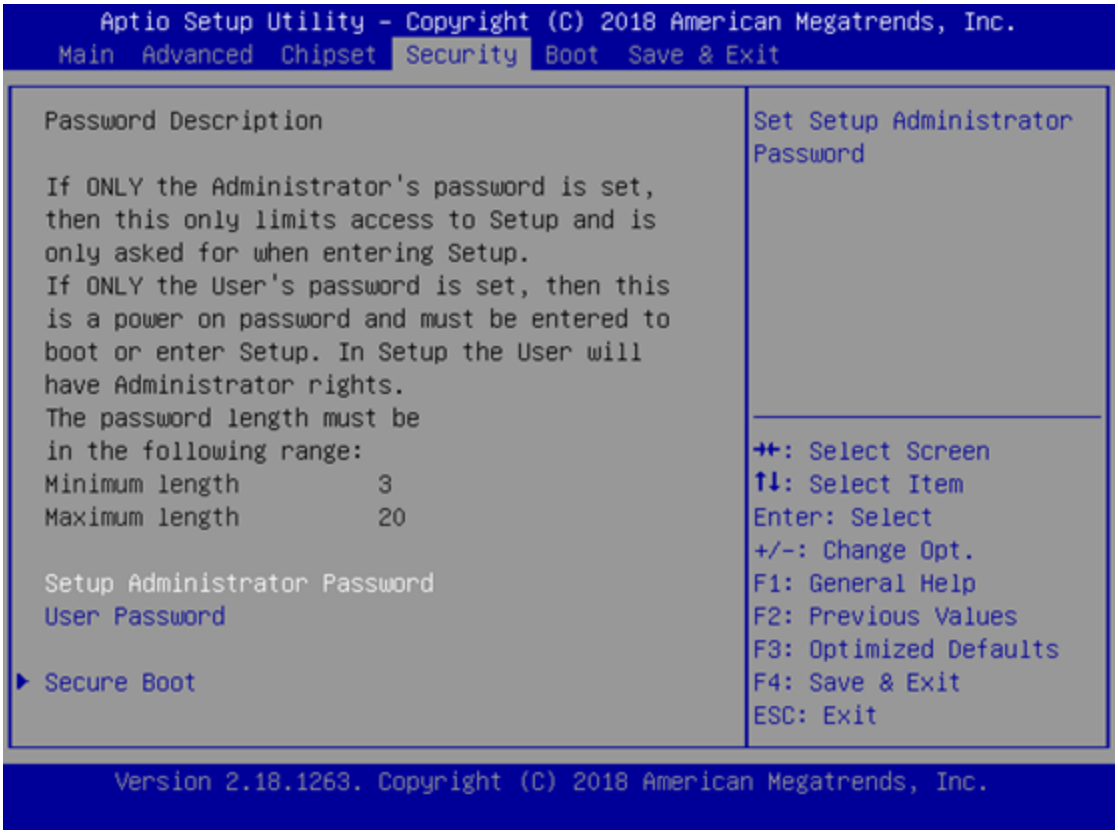
9.3.1 North Bridge

- Max TOLUD
- Above 4GB MMIO BIOS assignment

9.3.2 South Bridge & Cluster

- OS Selection
- Serial IRQ Mode
- SATA Drive configuration
- USB Configuration (xHCI Mode)
- Misc Settings (e.g., Restore on AC Power Loss)

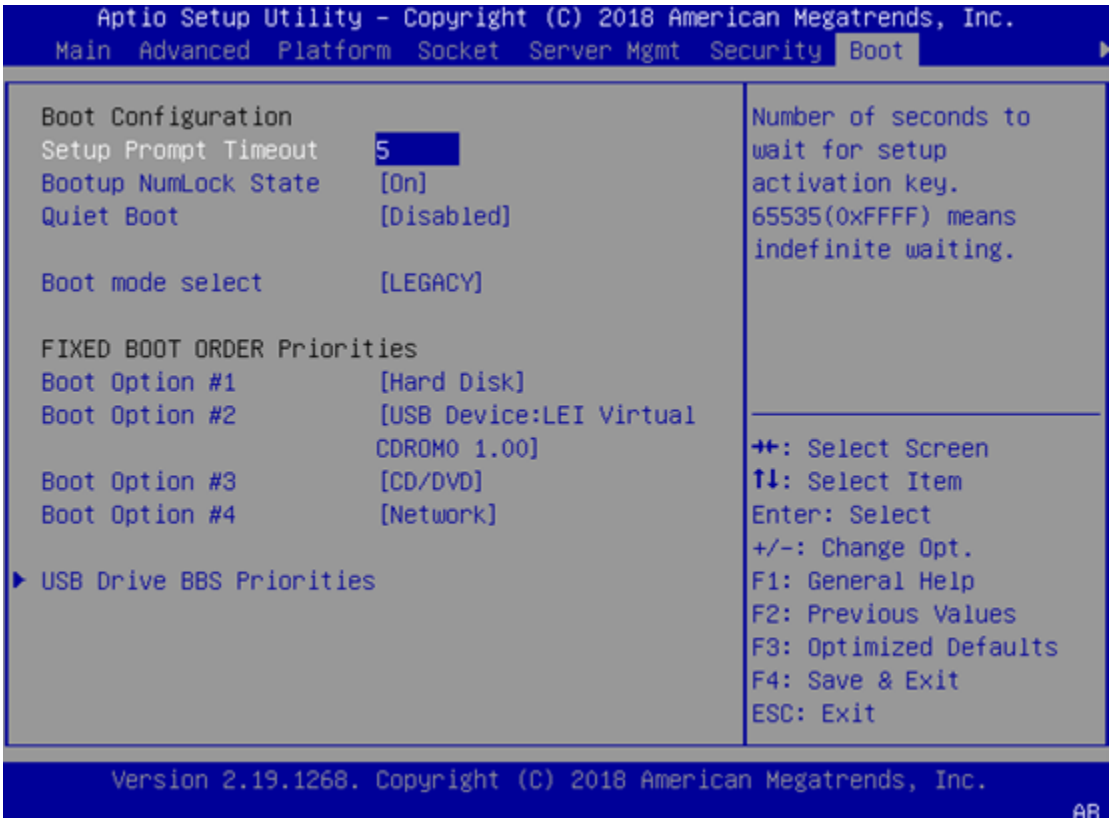
9.4 Security Page



Configure user and administrator access:

- **Administrator Password**
- **User Password**
- **Secure Boot** (Enable/Disable, Mode, Key Management)

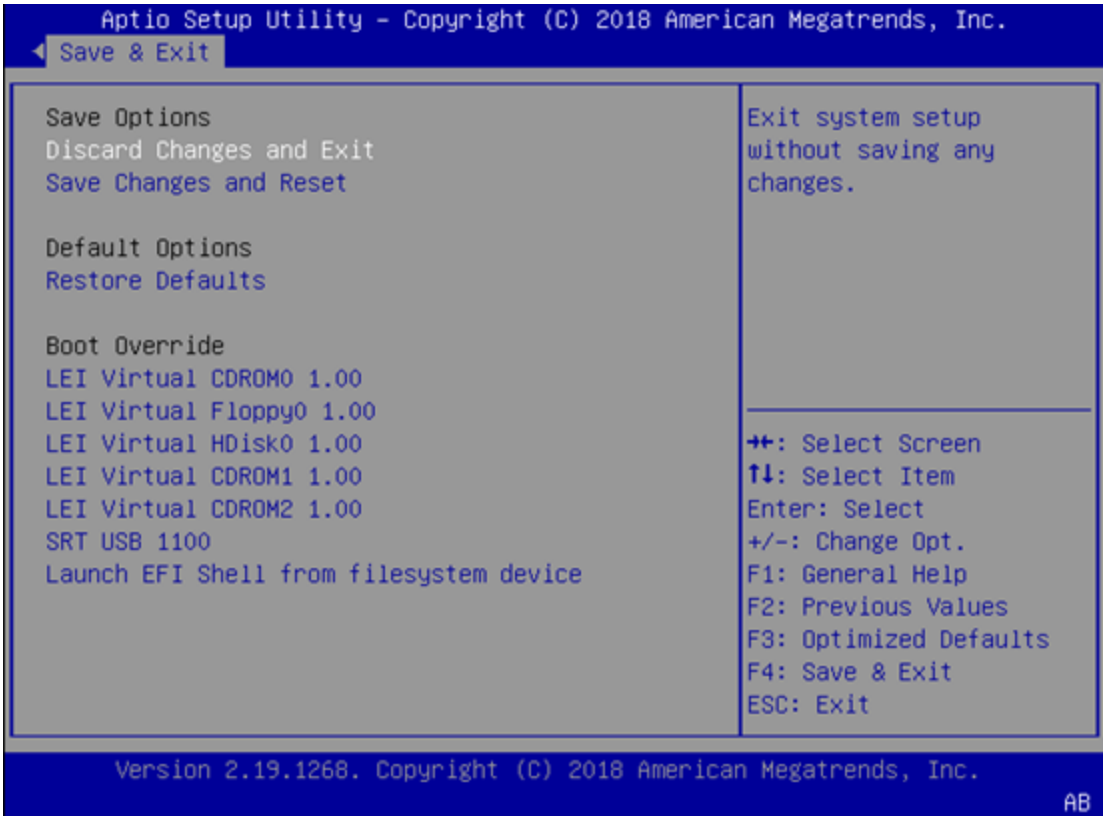
9.5 Boot Menu



Set the order and behavior of bootable devices:

- **NumLock state, Quiet Boot, Boot Mode (Legacy/UEFI)**
- **Timeout value and boot priorities**

9.6 Save & Exit



- **Save Changes and Reset**
- **Discard Changes and Exit**
- **Restore Defaults**

  BIOS firmware updates and downloads are available here.

10 Appendix A: LED Indicator Explanations

Component	LED Status	Meaning
SSD Activity	Blinking Amber	Data access activity
	Off	No data access activity
System Status	Solid Green	Defined by GPIO
	Solid Red	Defined by GPIO
	Off	Defined by GPIO
System Power	Solid Green	The system is powered on
	Off	The system is powered off
LTE Status	Blinking Amber	Link established and activity on port
	Solid Amber	Link established, no activity
	Off	No link is established
LAN Port (L1–L5) – *Link Activity*	Blinking Amber	Link established and activity on port
	Solid Amber	Link established, no activity
	Off	No link is established
LAN Port (L1–L5) – *Speed*	Solid Amber	Operating at 100 Mbps
	Solid Green	Operating at 1 Gbps
	Off	Operating at 10 Mbps
SFP Port (S1–S2)	Blinking Amber	Fiber activity on this port
	Solid Amber	Fiber link status
	Off	No link is established
COM Port (C1–C2) – *TX Activity*	Blinking Amber	Data transmitting
	Off	No data activity
COM Port (C1–C2) – *RX Activity*	Blinking Amber	Data receiving
	Off	No data activity

11 Appendix B: Setting Up Console Redirections

Console redirection lets you monitor and configure a system from a remote terminal computer by re-directing keyboard input and text output through the serial port. The following steps illustrate how to use this feature. The BIOS of the system allows the redirection of the console I/O to a serial port. With this configured, you can remotely access the entire boot sequence through a console port.

1. Connect one end of the console cable to console port of the system and the other end to the serial port of the Remote Client System.
2. Configure the following settings in the BIOS Setup menu: *BIOS* > *Advanced* > *Serial Port Console Redirection* > *Console Redirection Settings*, select *115200* for the Baud Rate, None. for Flow control, 8 for the Data Bit, None for Parity Check, and 1 for the Stop Bit.
3. Configure console redirection related settings on the client system. You can use a terminal emulation program that features communication with serial COM ports such as *TeraTerm* or *Putty*. Make sure the serial connection properties of the client conform to those for the server.