Armadillo-J

AJ010
Hardware Manual

Version 1.07

December 20, 2004

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1. Introduction

Thank you for purchasing the Armadillo-J [AJ010].

The Armadillo-J, a super small network computer, employs a 32-bit ARM processor (Netsilicon NS7520) and comes with 10Base-T/100Base-Tx (Power over Ethernet / IEEE802.3af), RS232C serial interface, parallel I/O, and built-in Ethernet.

Also, as the Armadillo-J employs µCLinux as its standard operating system, the user can take advantage of GNU's assembler or C compiler etc. for application development.

■

This manual provides information on the Armadillo-J's hardware specifications and methods of use.   We hope the information contained in this document will help you get the best functionality out of the Armadillo-J.

2. Precautions

2.1. Safety Precautions

Before using the Armadillo-J, read the following safety precautions carefully to assure correct use.

⚠	This product uses semiconductor components designed for generic electronics equipment such as office automation equipment, communications equipment, measurement equipment and machine tools. Do not incorporate the product into devices such as medical equipment, traffic control systems, combustion control systems, safety equipment and so on which can directly threaten human life or pose a hazard to the body or property due to a malfunction or failure. Moreover, products incorporating semiconductor components can be caused to malfunction or fail due to foreign noise or surge. To avoid serious injury or death in the worst case of malfunction or failure, be sure to take all possible measures in the safety system design, for example using protection circuits such as limit switches or fuse breakers, or system multiplexing.

2.2. Operational Precautions

To avoid permanent damage to the Armadillo-J, the following precautions must be observed when handling it.

- Power-on:
  Do not attempt to connect or disconnect GPIO connectors while power is applied to the Armadillo-J or peripheral circuits.

- Static Electricity:
  The Armadillo-J uses CMOS devices.   Until it is used, store it safely in the antistatic package provided at shipment.

- Latch-up
  Due to excessive noise or a surge from the power supply or the input/output, as well as sharp voltage fluctuations, the CMOS devices incorporated in the board can cause a latch-up.   Once the latch-up occurs, this situation continues until the power supply is disconnected, and therefore can damage the devices.   It is recommended to take safety measures such as adding a protection circuit into the noise-susceptible input/output line or not sharing the power supply with devices that can be the cause of noise.

2.3. Software Related Precautions

- Software contained in the product:
  The software and documentation contained in the product are provided "AS IS" without warranty of any kind, including warranty of merchantability or fitness for a particular purpose, reliability, or accuracy. Furthermore, we do not guarantee any outcomes resulting from the use of the product.

2.4. Trademarks

Armadillo is a registered trademark of Atmark Techno Inc.
Other company and product names are registered trademarks or trademarks of the respective company or organization.

3. Overview

3.1. Function Overview

The main Armadillo-J specifications are shown in Table 3-1.

Table 3-1 Armadillo-J Specifications

CPU	32-bit ARM7 Processor with Netsilicon NS7520
System Clock	CPU clock: 55.2960MHz BUS clock: 55.2960MHz
Memory	SDRAM: 8MByte (16bit width) FLASH: 2MByte(16bit width)
LAN Interface	10Base-T/100Base-Tx Power over Ethernet (IEEE802.3af compatible) * Compatible with devices that supply power through the No. 4 and 5 pin pair or the No. 7 and 8 pin pair.
Serial Port	1 channel (asynchronous mode, Max:230.4kbps) RS232C level I/O Flow control (CTS,RTS,DTR,DSR,DCD) D-Sub9 pin (male)
Parallel I/O (GPIO)	5 bits (common to the serial port's Modem control pin)
Timer	27 bits, 2 channels (1 channel is used for Linux system timer)
GPIO Connector (Option)	10-pin (2.54mm pitch right angle)
PCB size (mm)	50 × 37.5 (excludes projections)
Case size (mm)	W=45 H=26.5 D=79 (excludes projections)
Operational Temperature	0～40℃
Power Supply	DC8V～48V
Power Consumption	1.2W(Typ.)

3.2. Block Diagram

The block diagram of the Armadillo-J is shown in Figure 3-1.
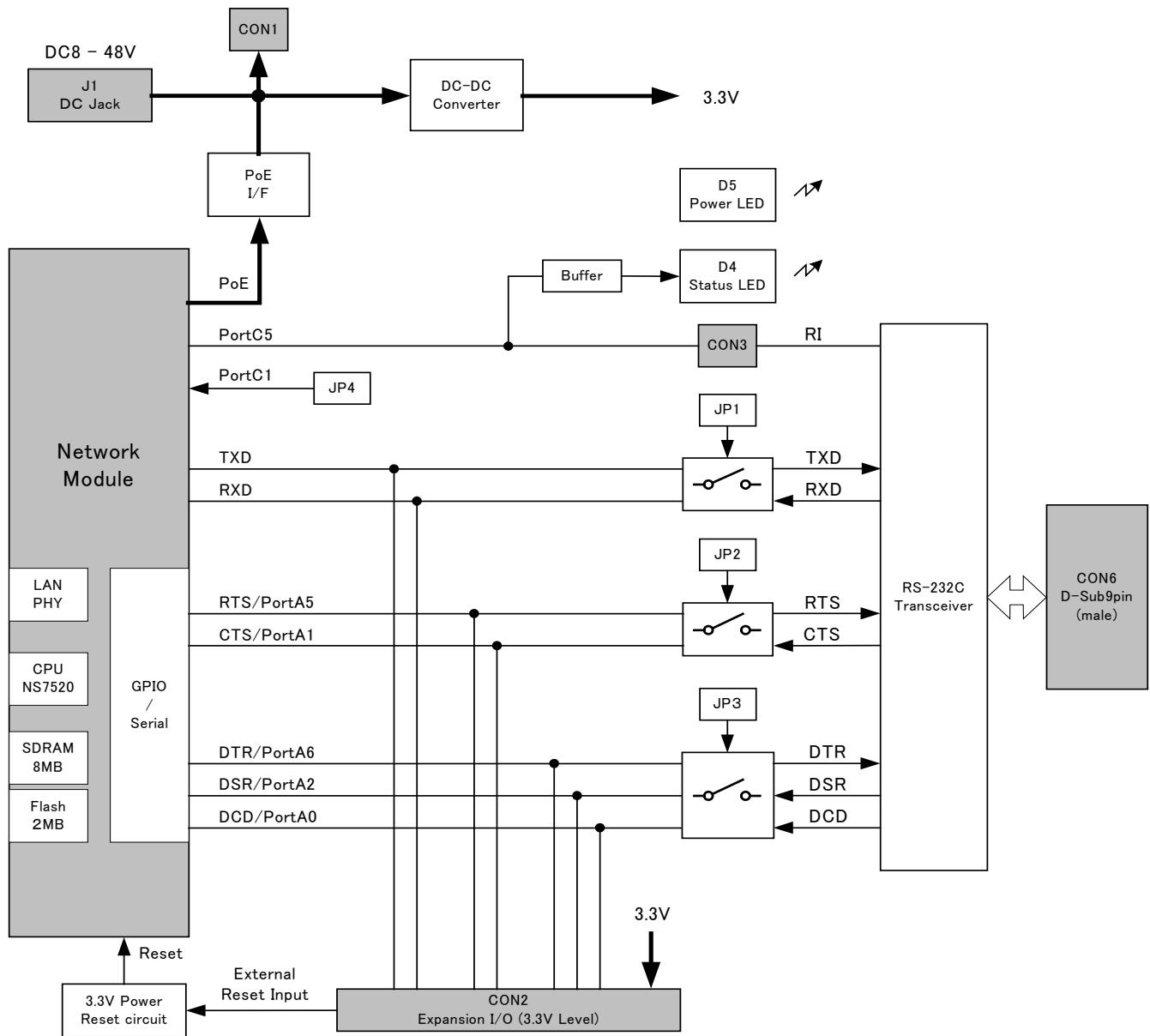
Figure 3-1 Armadillo-J Block Diagram

3.3. Operational Overview

After power-on, programs are executed in the following sequence.
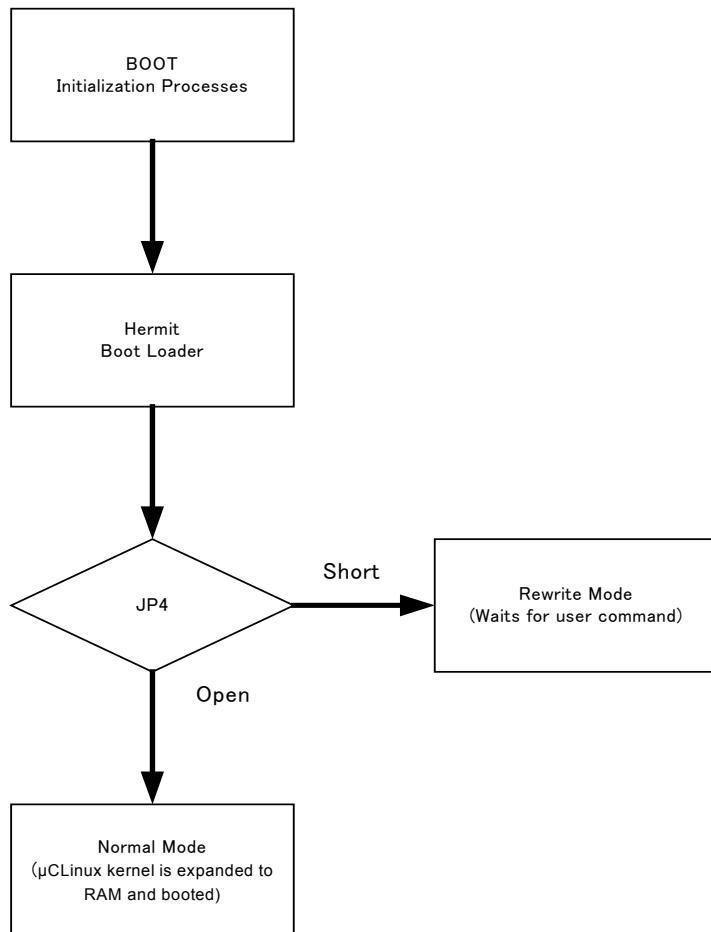
Figure 3-2 Armadillo-J Initialization Flowchart

* After power on, each I/O port on the Armadillo-J functions as a serial control signal until µCLinux is activated.   If the Armadillo-J is connected to an external device, be careful of I/O signal direction and status.

Table 3-2 I/O Port Status in Each State

Program	I/O Port
BOOT	Serial control signal
Hermit	Serial control signal
µCLinux	Based on user setting

4. Memory Map

4.1. The Armadillo-J Memory Map

The Armadillo-J memory map is shown in Table 4-1.

Table 4-1 Armadillo-J Memory Map

Start Address	End Address	Device	Memory Area	Setting
0x0000 0000	0x007F FFFF	SDRAM (8MB)	CS1	16bit-width
0x0080 0000	0x01FF FFFF	Reserved		
0x0200 0000	0x021F FFFF	Flash Memory (2MB)	CS0	16bit-width
0x0220 0000	0xFF6F FFFF	Reserved		
0xFF80 0000	0xFFDF FFFF	NS7520 Internal Register	CPU Register	
0xFFE0 0000	0xFFFF FFFF	Reserved		

5. Interface Specifications

5.1. Layout of Interfaces

The Armadillo-J interface layout is shown in Figure 5-1.
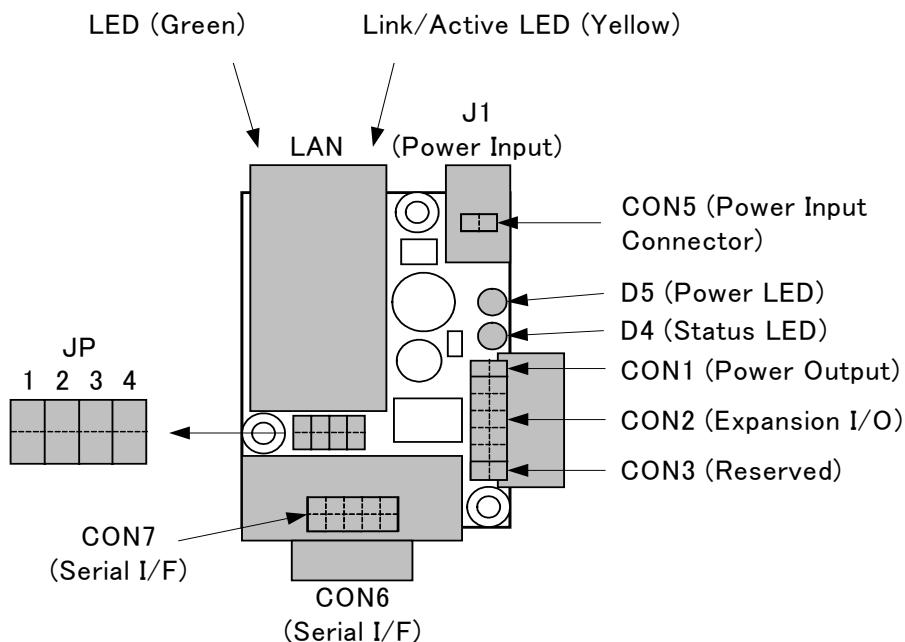
Figure 5-1 Layout of Interfaces

Table 5-1 Description of Interfaces

Interface	Description
LAN	LAN connector (10Base-T/100Base-Tx)
CON1	Power output
CON2	General purpose I/O connector *used only for general purpose I/O connectors (AJ010-CB0)
CON3	(Reserved)
CON5	Operating power input connector 2-pin (2.54mm pitch)
CON6	Serial interface D-Sub9-pin (male)
CON7	Serial interface 10-pin (2.54mm pitch)
JP1	TXD/RXD enable jumper
JP2	RTS/CTS enable jumper
JP3	DTR/DSR/DCD enable jumper
JP4	Switching jumper for operational mode
D4	Armadillo-J status LED (Red)
D5	Power LED (Green)
LED	Unused LED (Green) - Always lights while power is turned on.
Link/Active LED	LAN Link/Active LED (Yellow)
J1	Operating power input DC jack

5.2. LAN (LAN Connector)

   This is a LAN interface for 10Base-T/100Base-Tx connection.   It can connect to category 5 and higher Ethernet cables.   While generally it is used to connect to a HUB via a straight cable, it can also be directly connected to another PC or other devices using a cross cable.

   The LAN connector supports Power over Ethernet (IEEE802.3af).   It allows for power to be supplied via a single Ethernet cable using a Power over Ethernet device.

* To implement a Power over Ethernet connection, you will need a fully pin connected cable.
* An AC adaptor and Power over Ethernet cannot be used at the same time.   Select either one of the two power sources.   Otherwise, a switchover to the other power source may occur, where power is momentarily cut and the system is forced to reboot.
* When using Power over Ethernet and the LAN connector is re-inserted, it may take a few seconds for power distribution to resume while the HUB checks the operational status of the receiving end. This however has no operational effect.

Table 5-2 LAN Signal Assignment

No.	Signal Name	I/O	Function
1	TX＋	O	Differential twist pair transmit output (+)
2	TX－	O	Differential twist pair transmit output (-)
3	RX＋	I	Differential twist pair receive input (+)
4	VETH＋	－	Power over Ethernet (IEEE802.3af) power supply ＋
5	VETH＋	－	Power over Ethernet (IEEE802.3af) power supply ＋
6	RX－	I	Differential twist pair receive input (-)
7	VETH－	－	Power over Ethernet (IEEE802.3af) power supply －
8	VETH－	－	Power over Ethernet (IEEE802.3af) power supply －

5.3. CON1 (Power Supply Output)

   CON1 is an external output power supply connector.   It outputs power supply from the AC adaptor or Power over Ethernet.   Output voltage is determined by the supplied power voltage.

● Armadillo-J power consumption[*1] while using Power over Ethernet: Must be less than 12.95W[*2]. (Standard power consumption of Armadillo-J is approx. 1.2W).
● Armadillo-J consumption current[*3] while using the AC adapter: Must be less than 700mA[*2].

*1   Total power consumption for CON1 power output, CON2's 3.3V power output and Armadillo-J's internal circuits.
*2   Due to environmental circumstances, the Armadillo-J may not work properly even below the maximum rating.
*3   Total consumption current for CON1 power output, CON2's 3.3V power output and Armadillo-J's internal circuits.

Table 5-3 CON1 Signal Assignment

No.	Signal Name	I/O	Function
1	Power out	Power	External output power supply (DC8V～48V) For Power over Ethernet: DC48V
2	GND	Power	External output power supply (GND)

5.4. CON2 (GPIO)

CON2 is a CMOS3.3V interface general purpose I/O. It connects to serial I/O, 3.3V, GND and reset signals and can interface with external devices.

Table 5-4 CON2 Signal Assignment

No.	Signal Name	Port No.	I/O	Function
1	RXD	—	I	Serial data receive
2	TXD	—	O	Serial data transmit
3	RTS/PORTA5	4	I/O	Serial control signal or I/O port (built-in10kΩ pull-up)
4	DTR/PORTA6	5	I/O	Serial control signal or I/O port (built-in10kΩ pull-up)
5	CTS/PORTA1	2	I/O	Serial control signal or I/O port (built-in10kΩ pull-up)
6	DSR/PORTA2	3	I/O	Serial control signal or I/O port (built-in10kΩ pull-up)
7	DCD/PORTA0	1	I/O	Serial control signal or I/O port (built-in10kΩ pull-up)
8	RESET*	—	I	External reset input (to be reset with shorted GND) ** Open corrector/open drain signal input is also allowed.* ** Hi level signal input is not allowed.*
9	+3.3V	—	Power	Power supply (+3.3V) ** Maximum output current: 400mA (includes consumption current of Armadillo-J internal circuits)*
10	GND	—	Power	Power supply (GND)

Electrical specifications of GPIO are shown in Table 5-5.

Table 5-5 Electrical Specifications of GPIO

Symbol	Parameter	Min	Max	Unit	Conditions
V_{IH}	CMOS Input high voltage	2	3.45	V	
V_{IL}	CMOS Input low voltage	-0.3	0.2×Vcc	V	Vcc=3.3V
V_{OH}	CMOS Output high voltage	2.4	3.45	V	I_{OH}=2mA$_{MAX}$
V_{OL}	CMOS Output low voltage	0	0.4	V	I_{OL}=-2mA$_{MAX}$
I_{IL}	Input leakage current		10	µA	V_{IN}=Vcc or GND

5.5. CON3 (Reserved)

Proper operation is not guaranteed when using this connector.

5.6. CON5 (Operating Power Input Connector)

J1 is a 2-pin connector that feeds power to the Armadillo-J.   Input voltage range is DC8V - 48V.

The Armadillo-J allows for power input by Power over Ethernet (PoE)* as well as that from CON5 or the DC jack.

*Power over Ethernet (IEEE802.3af) is a standard for feeding power to individual devices using a LAN cable.

Table 5-6   CON5 Signal Assignment

No.	Signal Name	I/O	Function
1	Power in	Power	Operating power input (DC8V - 48V)
2	GND	Power	Operating power input (GND)

5.7. CON6 & CON7 (Serial Interface)

CON6 and CON7 are asynchronous serial interfaces.

CON6 and CON7 have different connector designs and pin assignments.   However, they do have the same serial signals.

- Signal input/output level: RS232C
- Maximum data rate: 230.4kbps
- Flow control: CTS, RTS, DTR, DSR, DCD
- FIFO: 32 bytes built-in for both transmit and receive
- CON6:   D-Sub9-pin connector
- CON7:   10-pin (5×2)2.54mm pitch connector

Table 5-7 CON6 Signal Assignment

No.	Signal Name	I/O	Function
1	DCD	I	Connects to DCD/PORTA0-pin via 3-state buffer
2	RXD	I	Connects to RXD-pin via 3-state buffer
3	TXD	O	Connects to TXD-pin via 3-state buffer
4	DTR	O	Connects to DTR/PORTA6-pin via 3-state buffer
5	GND	Power	GND
6	DSR	I	Connects to DSR/PORTA2-pin via 3-state buffer
7	RTS	O	Connects to RTS/PORTA5-pin via 3-state buffer
8	CTS	I	Connects to CTS/PORTA1-pin via 3-state buffer
9	RI	I	Connects to #1-pin on CON3

Table 5-8 CON7 Signal Assignment

No.	Signal Name	I/O	Function
1	GND	Power	GND
2	RI	I	Connects to #1 pin on CON3
3	DTR	O	Connects to DTR/PORTA6-pin via 3-state buffer
4	CTS	I	Connects to CTS/PORTA1-pin via 3-state buffer
5	TXD	O	Connects to TXD-pin via 3-state buffer
6	RTS	O	Connects to RTS/PORTA5-pin via 3-state buffer
7	RXD	I	Connects to RXD-pin via 3-state buffer
8	DSR	I	Connects to DSR/PORTA2-pin via 3-state buffer
9	DCD	I	Connects to DCD/PORTA0-pin via 3-state buffer
10	+3.3V	Power	Power Supply (+3.3V)

5.8. JP1 (TXD/RXD Enable Jumper)

JP1 is a jumper used to connect or disconnect the TXD/RXD signals of the network module to the serial interface.   If disconnected, the user can freely control TXD/RXD using CON2 (general purpose I/O).
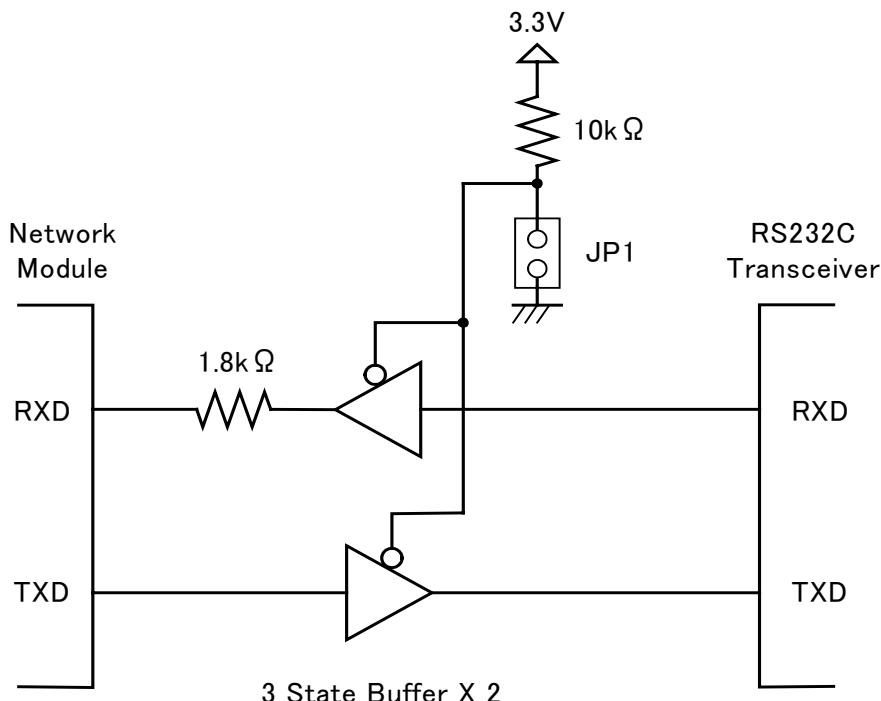
Figure 5-2 TXD/RXD Circuit

Table 5-9 JP1 Function

JP1 State	Function
Closed	The TXD/RXD of the network module and the serial interface are connected.
Open	The TXD/RXD of the network module and the serial interface are disconnected.

* If the RXD of the network module is set to Output Port and JP1 to Closed, this can cause an output-to-output collision and current overload, resulting in damage to elements.   *Thus, be careful not to set JP1 to Closed if RXD is used as an output port.*
* *Be sure to turn off the power before performing a jumper switching.*

5.9. JP2 (RTS/CTS Enable Jumper)

JP2 is a jumper used to connect or disconnect the RTS/PORTA5, CTS/PORTA1 signals of the network module to the serial interface. If disconnected, the user can freely control them using CON2 (general purpose I/O).
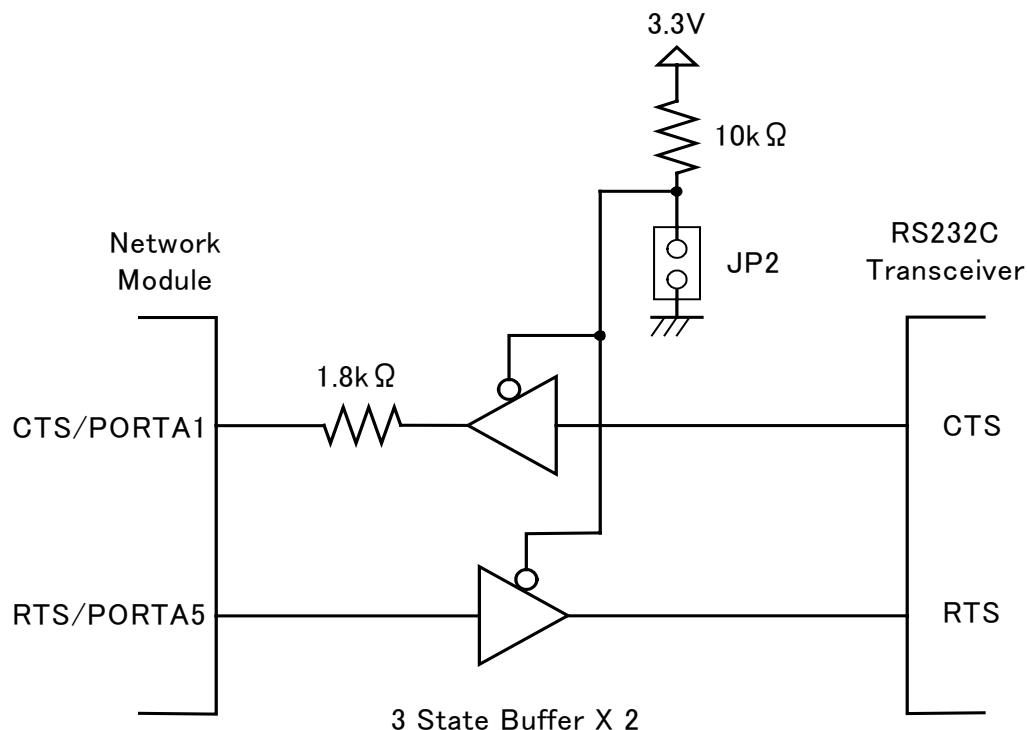
**Figure 5-3 RTS/CTS Circuit**

Table 5-10 JP2 Function

| JP2 State	Function
Closed	The CTS/RTS of the network module and the serial interface are connected.
Open	The CTS/RTS of the network module and the serial interface are disconnected.

* If the CTS/PORTA1 of the network module is set to Output Port and JP2 to Close, this can cause an output-to-output collision and current overload, resulting in damage to elements. *Thus, be careful not to set JP1 to Closed if **CTS/PORTA1** is used as an output port.*

* *Be sure to turn off the power before performing a jumper switching.*

5.10. JP3（DTR, DSR and DCD Enable Jumper）

JP3 is a jumper used to connect or disconnect the DTR/PORTA6, DSR/PORTA2, and DCD/PORTA0 signals of the network module to the serial interface. If disconnected, the user can freely control them using CON2 (general purpose I/O).
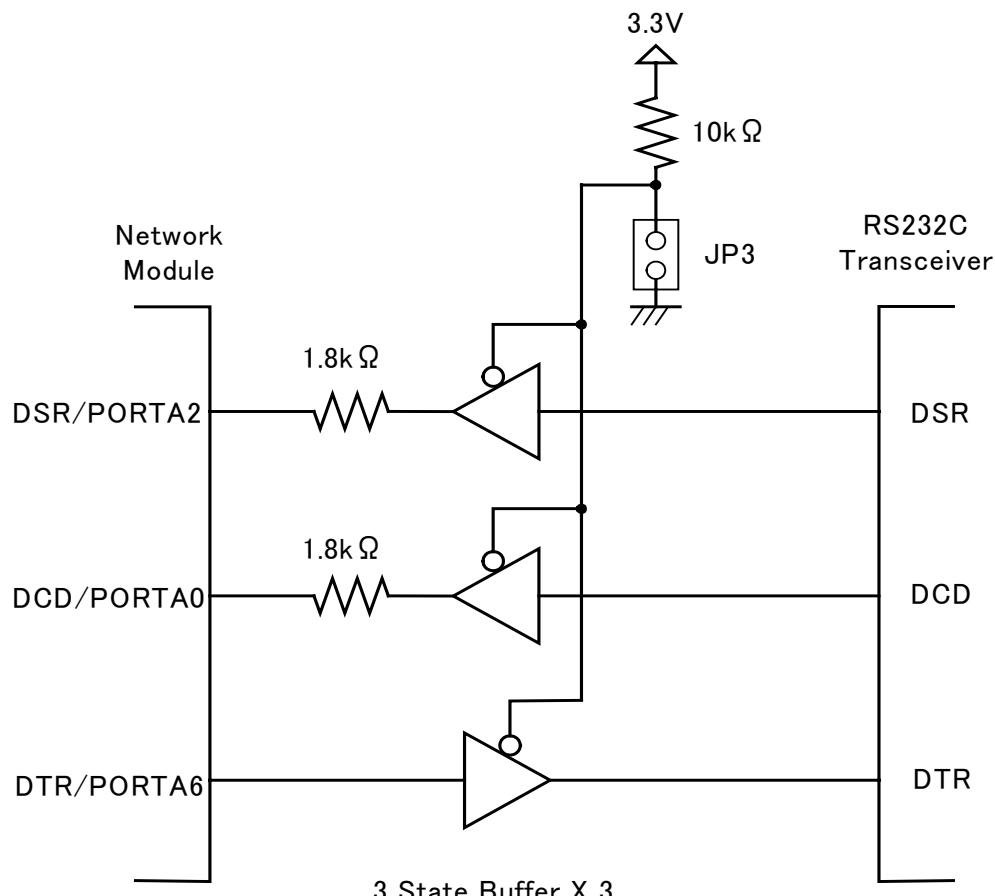
Figure 5-4 DTR/DSR/DCD Circuit

Table 5-11   JP3 Function

JP3 Setting	Function
Closed	The DTR/DSR/DCD of the network module and the serial interface are connected.
Open	The DTR/DSR/DCD of the network module and the serial interface are disconnected.

* If DSR/PORTA2 or DCD/PORTA0 of the network module is set to Output Port and JP3 to Closed, this can cause an output-to-output collision and overload current, resulting in damage to elements. *Thus, be careful not to set JP3 to Close if **DSR/PORTA2 or DCD/PORTA0** is used as an output port.*
* *Be sure to turn off the power before performing a jumper switching.*

5.11. JP4 (Operating Mode Switch Jumper)

JP4 is a jumper used to activate Hermit when the Armadillo-J is booted.

Table 5-12 JP4 Function

JP3 Setting	Function
Closed	Activates Hermit (rewriting mode)
Open	Activates µCLinux (normal operating mode)

5.12. D4 (Armadillo-J Status LED)

D4 is a lamp used to monitor the operating status of the Armadillo-J.
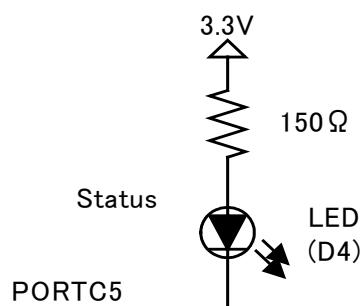
Figure 5-5 LED (D4) Connection

5.13. D5 (Power LED)

LED (D5) shows the power status of the Armadillo-J.
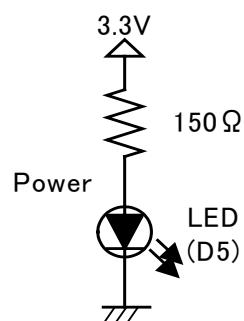
Figure 5-6 LED (D5) Connection

5.14. LAN LED (Network Link/Activity)

The yellow LED on the upper position of the LAN connector represents the LAN operating status.   The green is currently unused (it lights in normal operating mode).
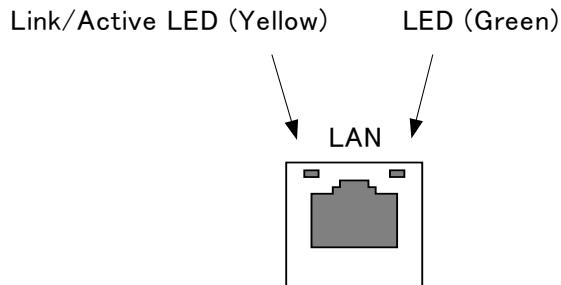
Figure 5-7   LAN LED

Table 5-13   Status of Yellow and Green LEDs

LED	Name	ON	OFF	Flashing
Yellow	Network Link/ Activity	A LAN cable is connected and a 10Base-T/100Base-Tx link is established.	A LAN cable is not connected or the destination device is not active.	Data is being transmitted and/or received.
Green	Unused	Power is being supplied.	—	—

5.15. J1 (DC Jack for Operating Power Input)

J1 is a DC jack used to supply power to the Armadillo-J.   It has input voltage range of DC8V - 48V.

The AC adapter has a jack configuration of a 5.5 mm circumference and a 2.1 mm pin hole, allowing the use of connectors with the same polarity marking shown in Figure 5-8.

Additionally the Armadillo-J allows for power input via Power over Ethernet* as well as from the DC jack or CON5.

Caution1:   An AC adaptor and Power over Ethernet* cannot be used at the same time Select either one of the two power sources.   Otherwise, a switchover to the other power source may occur, where power is momentarily cut and the system is forced to reboot.

Caution2:   If a high voltage AC adapter that exceeds 12V is used, a spark can be caused at the point of contact when connecting the plug to the Armadillo-J.   Therefore, if a high voltage AC adapter is being used, be sure to first connect the Armadillo-J to the AC adapter and then connect the adapter to the outlet.

* Power over Ethernet (IEEE802.3af) is an electrical standard for supplying the power via a LAN cable.

Figure 5-8 AC Adapter Polarity Mark

5.16. Connecter Type

The connecter types of CON2, CON6 and J1 are shown in Table 5-14.

Table 5-14 List of Connecter Types

Connecter	Maker	Type	Remarks
CON2	Omron	XG4C-1034	2×10 (2.54mm pitch)
CON6	LTI	1203-07	D-Sub9 pin (male)
J1	Marushin	MJ-179P	DC jack

6.I/O Port Registers

The Armadillo-J has two I/O ports, each of which provides the following functions.

● PORTA: Control of five GPIO/serial control signals and input/output serial data signals
● PORTC: Control of status LED (D4)

6.1. PORTA Configuration Register

The PORTA configuration register allows the following operations.

- Switching serial control signal and I/O port (writing to AMODE)
- Switching input/output direction on each I/O port (writing to ADIR)
- Reading each I/O port status (reading ADATA)
- Configuring output to each I/O port (writing to ADATA)

Table 6-1 provides detailed information on the PORTA configuration register.

Table 6-1 PORTA Configuration Register

Address : 0xffb0 0020

r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
AMODE7	AMODE6	AMODE5	AMODE4	AMODE3	AMODE2	AMODE1	AMODE0

Bit 31   Bit 24

r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
ADIR7	ADIR6	ADIR5	ADIR4	ADIR3	ADIR2	ADIR1	ADIR0

Bit 23   Bit 16

N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Bit 15   Bit 8

r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
ADATA7	ADATA6	ADATA5	ADATA4	ADATA3	ADATA2	ADATA1	ADATA0

Bit 7   Bit 0

The function of PORTA can be defined by AMODE/ADIR bit setting.   The port function by each mode is shown in Table 6-2.

Table 6-2 Port Function by PORTA Mode

AMODE	0		1	
ADIR	0	1	0	1
PORTA0	GPIO IN	GPIO OUT	DCD	
PORTA1	GPIO IN	GPIO OUT	CTS	
PORTA2	GPIO IN	GPIO OUT	DSR	
PORTA3	GPIO IN	GPIO OUT	RXD	
PORTA4				
PORTA5	GPIO IN	GPIO OUT		RTS
PORTA6	GPIO IN	GPIO OUT		DTR
PORTA7	GPIO IN	GPIO OUT		TXD

Note: The TXD/RXD can be used as GPIO.   However, if it is used as GPIO, the serial communication function is disabled.

6.2. PORTC Configuration Register

The PORTC configuration register allows the following operation.

● Controlling the ON/OFF status of LED (D4) (PORTC5)

The status LED can be controlled by placing PORTC5 in GPIO OUT mode and setting CDATA5 (Bit5) .

Table 6-3 CDATA5 and LED Status

CDATA5	LED
0	ON
1	OFF

Table 6-4 provides detailed information on the PORTC configuration register.

Table 6-4 PORTC Configuration Register

Address : 0xffb0 0028

r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
CMODE7	CMODE6	CMODE5	CMODE4	CMODE3	CMODE2	CMODE1	CMODE0

Bit 31   Bit 24

r/w	R/w	r/w	r/w	r/w	r/w	r/w	r/w
CDIR7	CDIR6	CDIR5	CDIR4	CDIR3	CDIR2	CDIR1	CDIR0

Bit 23   Bit 16

r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
CSF7	CSF6	CSF5	CSF4	CSF3	CSF2	CSF1	CSF0

Bit 15   Bit 8

r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
CDATA7	CDATA6	CDATA5	CDATA4	CDATA3	CDATA2	CDATA1	CDATA0

Bit 7   Bit 0

The function of PORTC can be switched by configuration of the CSF, CMODE and CDIR bits. Port function by each mode is shown in Table 6-5.

Table 6-5 Port Function by PORTC Mode

CSF	0				1			
CMODE	0		1		0		1	
CDIR	0	1	0	1	0	1	0	1
PORTC0								
PORTC1								
PORTC2								
PORTC3								
PORTC4								
PORTC5	GPIO IN	GPIO OUT						
PORTC6	GPIO IN	GPIO OUT						
PORTC7								

7. Reference Circuits

Reference circuits using CON2 (GPIO) are shown in Figure 7-1.

24V Relay Drive Circuit   LED Light Circuit

Button Switch Input Circuit
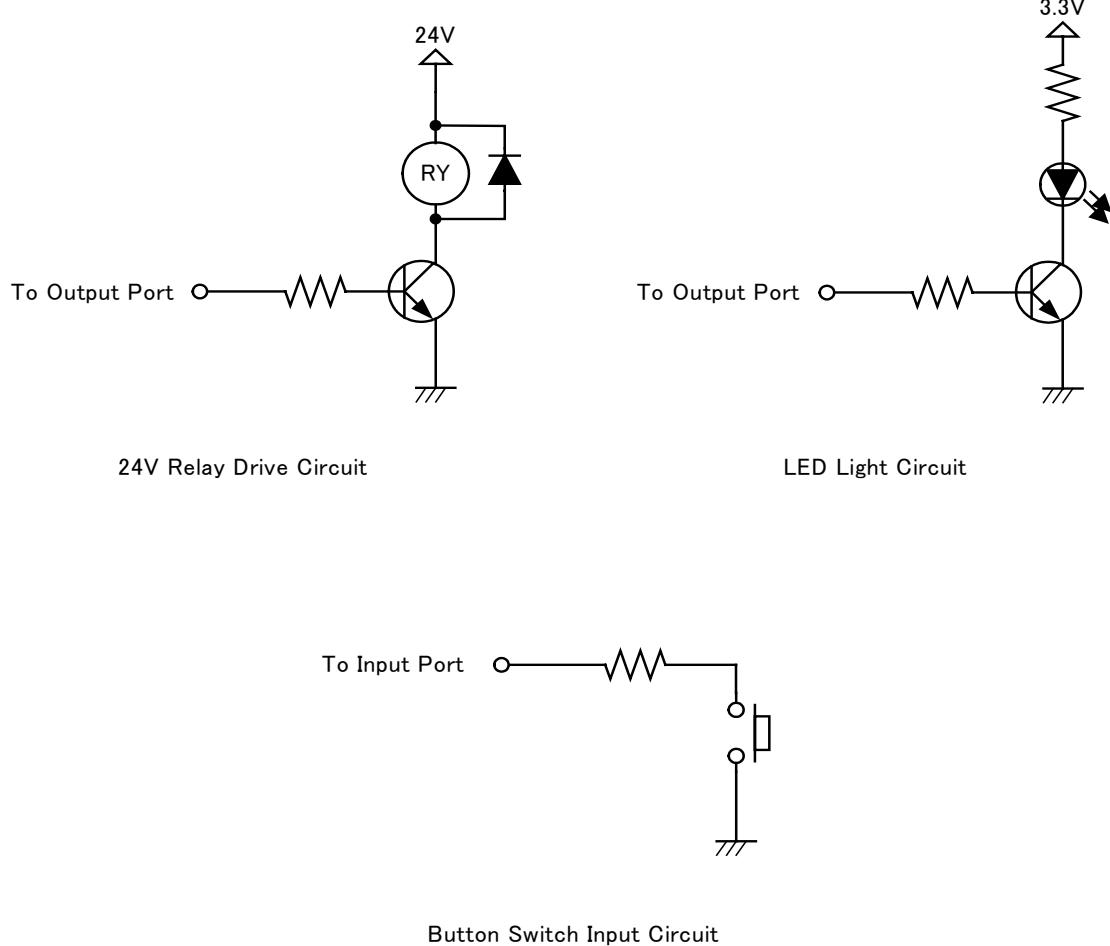
Figure 7-1 Reference Circuits

8. External View of Armadillo-J Board

The external view of the Armadillo-J [AJ010] board is shown in Figure 8-1.
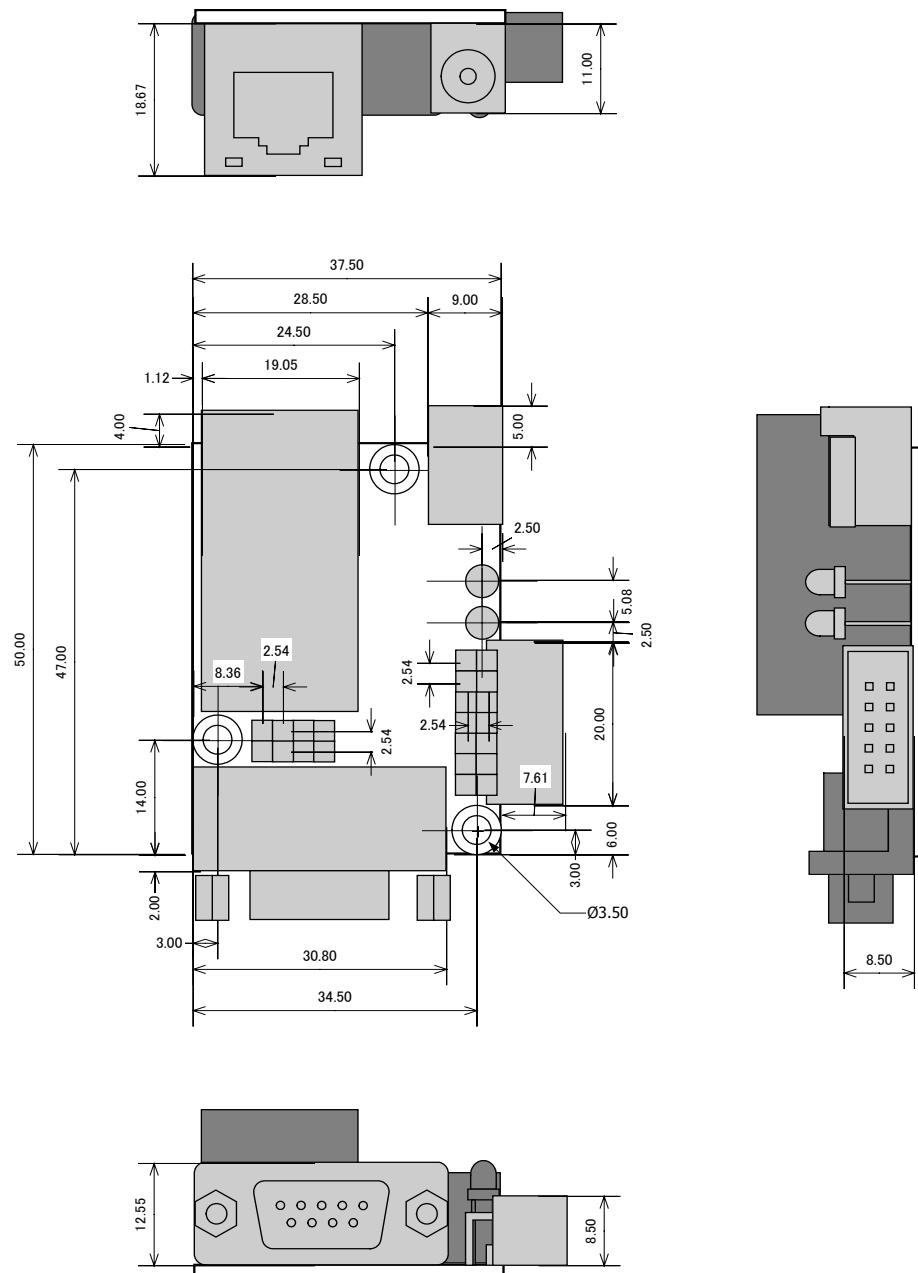
[Unit: mm]

Figure 8-1   External View of the Armadillo-J[AJ010] Board

9. External View of Armadillo-J Case

The external view of the Armadillo-J [AJ010] case is shown in Figure Figure 9-1.
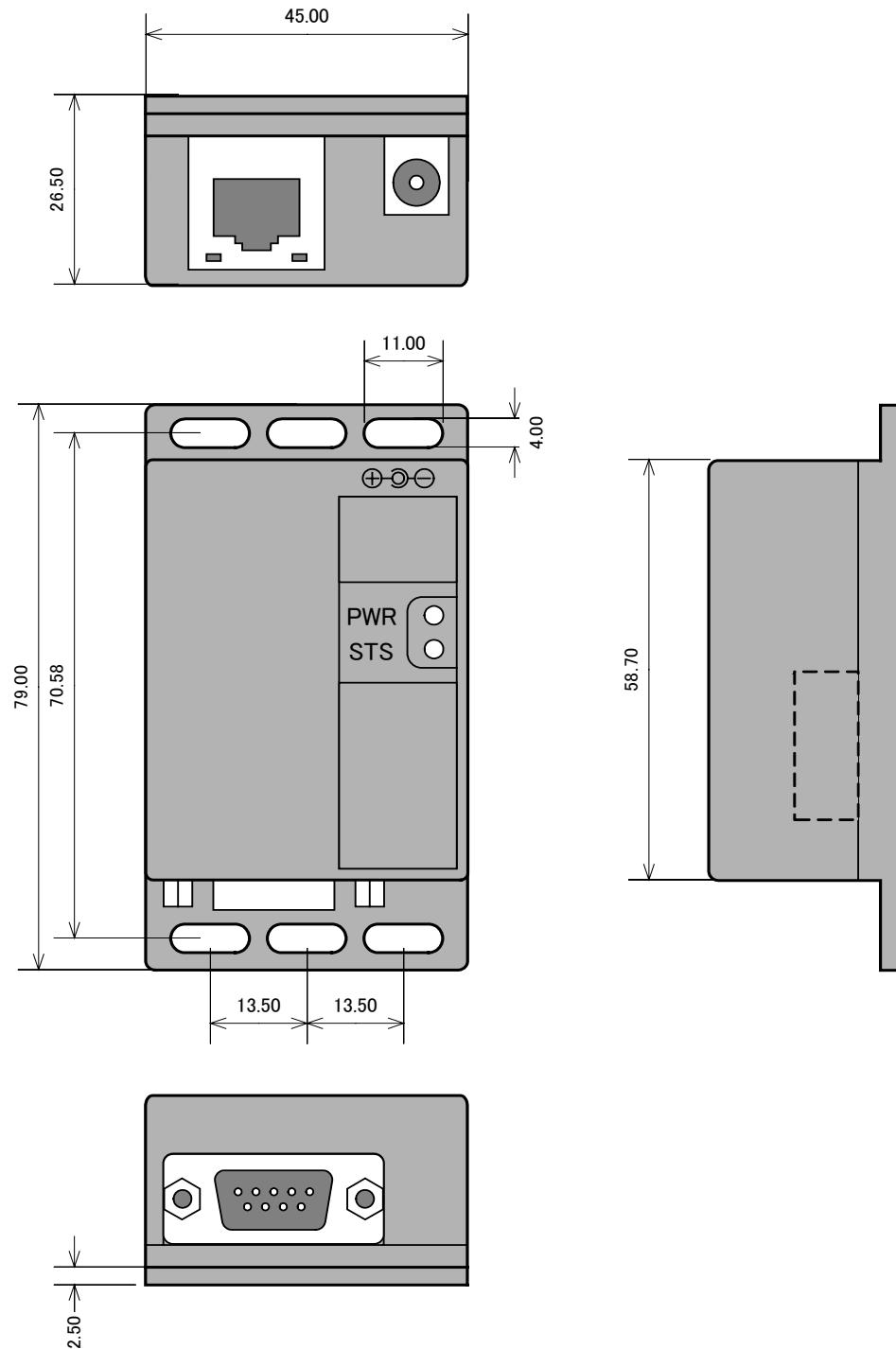
[Unit: mm]

Figure 9-1 External View of the Armadillo-J [AJ010] Case

Revision History

Version	Date	Description of Revision
1.00	2003.12.22	・Initial release
1.01	2003.12.26	・Addition of CON5 and CON7 in "Figure 5-1　Layout of Interfaces". ・Alteration of functional description in "5.14 LAN LED (Network Link/Activity)".
1.02	2004.1.9	・Addition of page numbers ・Deletion of the blank page following the cover sheet.
1.03	2004.1.22	・Correction to the Flash area in "Table 4-1　Armadillo-J Memory Map". ・Addition of text regarding simultaneous use of AC adapter and PoE in "5.2 LAN (LAN Connector)" and "5.15 J1 (DC Jack for Operating Power Input)".
1.04	2004.2.27	・Addition of cautions regarding the use of an AC adapter that exceeds 12V in "5.15 J1 (DC Jack for Operating Power Input）". ・Replacement of the term "Expansion I/O" with "General Purpose I/O". ・Addition of port numbers in "Table 5-4　CON2 Signal Assignment". ・Addition of "6.2 PORTC Configuration Register".
1.05	2004.3.9	・Addition of description about power delays when using PoE in "5.2 LAN (LAN Connector)".
1.06	2004.6.11	・Changing the maximum current value representation from "±2mA" to "±2mA$_{MAX}$" in "Table 5-5　Electrical Specifications of GPIO"
1.0.7	2004.12.20	・Updated company address