PL-ATS   AI TO RS485 Converter

■ DESCRIPTION

PL-ATS is an I/O controller product with Serial Port on its data communication and makes data acquisition easier through ModBus Protocol of RTU mode on Serial Bus.

It use the 8051's family microprocessor for implementing the whole framework. Basically, it equips 8 channels of single-ended analog input and two digital outputs in a set.

■ FEATURE

- **Support ModBus Protocol**
  - ▶ **Auto Detect ModBus RTU and ASCII Mode**
  - ▶ **Supported Modbus Function 01, 02, 03, 04, 05, 06, 10, 0F**
- **Configurable Parameters with Device ID Control**
  - ▶ **Configurable under Console Mode**
  - ▶ **Enable / Disable: When Device ID Control is enabled, it will reply the modbus requests only when the Device ID is correct**
- **Input abnormal Detection: Flag will be set while the input voltage or current got lower than low range or higher than high range.**
- **8 single ended input channels with 16bits A/D converter with optical isolation**
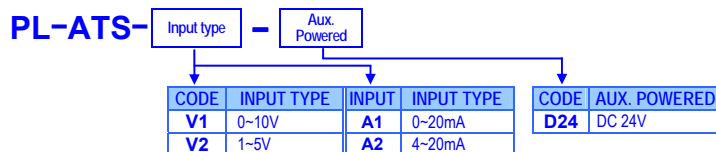- **Four models for Voltage: 0~10V/1~5V or Current: 0~20mA/4~20mA by dip-switch changeable**

■ APPLICATIONS

It is easy to convert AI and DO control to RS485 in IA, Factory Automation, Security or any other low data rate data transmission by using it as the intermediate converter.

- **Data collection**
- **Remote Sensors and Various Meters**
- **Access control terminals**
- **Environmental monitors**
- **Data loggers**

■ ORDERING INFORMATION

PL-ATS- [Input type] - [Aux. Powered]

CODE	INPUT TYPE	INPUT	INPUT TYPE		CODE	AUX. POWERED
V1	0~10V	A1	0~20mA		D24	DC 24V
V2	1~5V	A2	4~20mA			

■ TECHNICAL SPECIFICATION

CPU:	8051's family microprocessor
Network interface:	RS485,
Protocol:	Modbus/RTU, Modbus/ASCII, Console Mode
Reset:	Built-in reset key to restore the defaults
Watch dog timer:	Built-in hardware auto reset function

Analogue Input

	8 channels input *available*
Input ranges:	Voltage and Current changeable by dip-switch
	Voltage: 0~10V / 1~5V; input impedance 10MΩ
	Current: 0~20mA / 4~20mA; input impedance 250Ω
Resolution:	16 bits ADC
Accuracy:	± 0.2% at 25 ℃
Channels isolation:	Non-isolated (one common)
Temp. coefficient:	≤ 50PPM/ ℃ (at 25 ℃)
Sampling time:	800 ms / 8 channels

Digital output

	Open collect, 24V±10%, 0.5A
	Type: NPN/Sink
	ON status:15V or less voltage drop
	OFF status: 0.1mA or l less voltage drop
	Response: 8 msec or less
	External supply: 24V +/- 10%, 100mA
LED indication:	SYS: Red high bright round LED
	Link: Green high bright round LED
	RX: Green high bright round LED
	TX: Red high bright round LED
	DO: 2 Red high bright round LED

Configuration:	Configure by Hardware DIP Switch or Console (When DIP Device ID=0)
	Serial port:
Baud Rate:	2400 ~ 115200 bps
Data bits:	8 bits
Parity:	None
Stop Bit:	1 bits

Power

Power Supply:	DC 24V
Power consumption:	≤ 1W

Electrical

Isolation:	Isolated between AI, DO, Serial port and Power
Dielectric Strength:	3 KV, 1 minute; between AI / DO / Serial port / Power
Insulation resistance:	≥100MΩ at 500Vdc, Between AI / DO / Serial port / Power

Environmental

Operating temp.:	0~60 ℃
Operating humidity:	20~95 %RH, non-condensing
Storage temp.:	-10~70 ℃

Mechanical

Case Material:	ABS fire-protection (UL 94V-0)
Mounting:	Surface mounting
Terminal block:	Plastic NYLON 66 (UL 94V-0)
Weight:	150g

■ DIMENSIONS

FRONT VIEW

94.0
68.0
9.0
25.0
50.0
102.0
9.0
4xΦ3.0
(UNIT: mm)

■ INPUT RANGE & MODE SELECTION

| INPUT RANGE & MODE SELECTION		
DIP-SW	SW1	SW2
ON	Console Mode	1~5V / 4~20mA
OFF	Operation/Modbus Mode	0~10V / 0~20mA
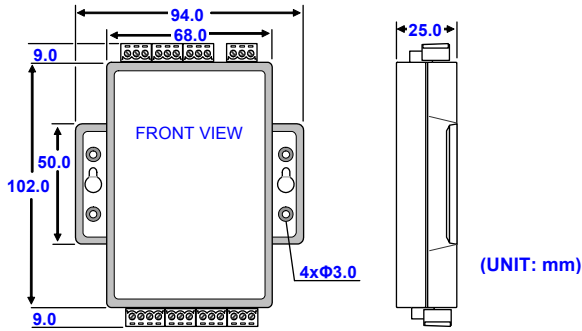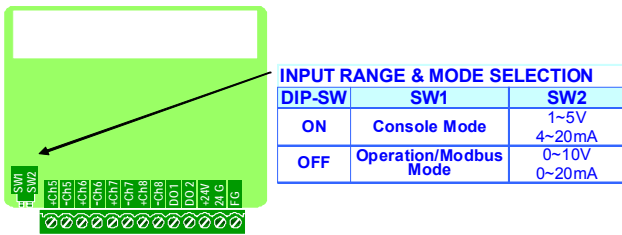
SW1 is used in Mode Selection while SW2 is used to change the range. And the selections for Voltage or Current needs to cooperate with J13 as below,

Just like the red circle on the picture, if the Jumpers were on (short circuit, closed circuit), PL-ATS will work in Current Mode; else it will work under Voltage mode. Once the Input Mode was selected, the SW1 and SW2 must be adjusted with the corresponded setting.
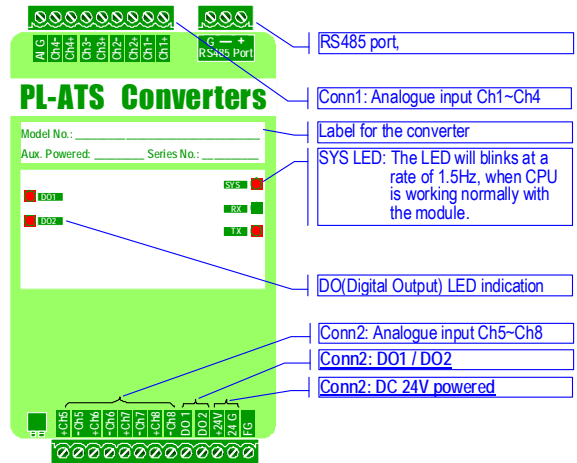
■ DEVICE ID SELECTION

RS485   Connector 1

BACK VIEW

8 7 6 5 4 3 2 1

Connector 2

2 1
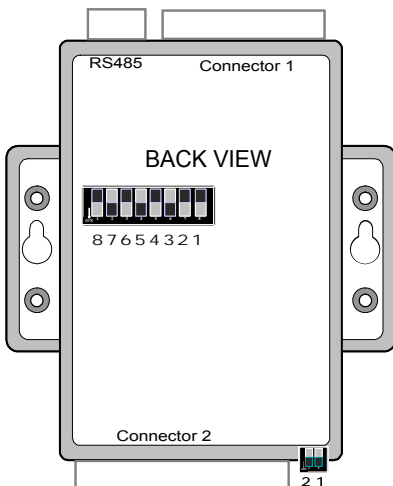
PIN Def.	PIN1		PIN2		PIN3		PIN4		PIN5		PIN6		PIN7		PIN8	
Status Value (ON / OFF)	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
Exp. Value	2^0		2^1		2^2		2^3		2^4		2^5		2^6		2^7	

Device ID = Sum of Corresponded Entry Value (Status Value x Exp. Value).

Example: PIN1, PIN2 ON, PIN3~PIN8 OFF -->
Device ID = 2^0x1+2^1x1 = 3

■ FRONT PANEL & CONNECTION

Please check the voltage of power supplied first, and then connect to the specified terminals.

PL-ATS Converters

Model No.: _____
Aux. Powered: _____ Series No.: _____

- RS485 port,
- Conn1: Analogue input Ch1~Ch4
- Label for the converter
- SYS LED: The LED will blinks at a rate of 1.5Hz, when CPU is working normally with the module.
- DO(Digital Output) LED indication
- Conn2: Analogue input Ch5~Ch8
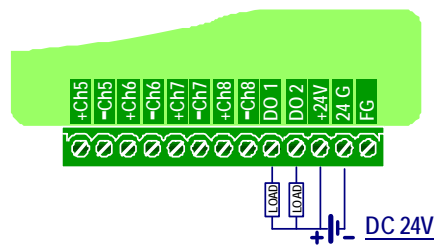- Conn2: DO1 / DO2
- Conn2: DC 24V powered

Users may refer to the following diagram to connect the external wiring for the PL-ATS module. (Wires for analog input signals are recommended to have the shielding protection)
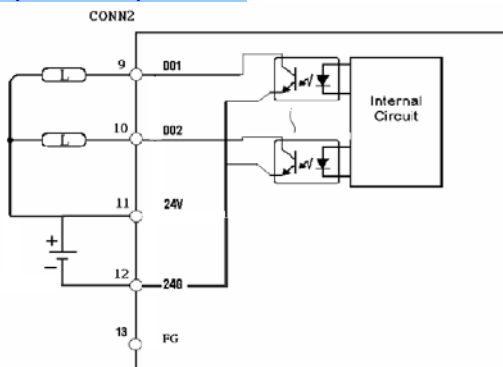
Analogue Input

Digital Output

DC 24V
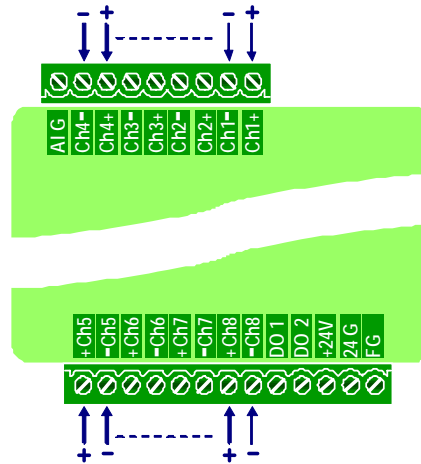
Equivalent Output Circuit

■ MODBUS ADDRESS FOR I/O

The I/O points of the PL-ATS can easily be controlled and monitored through Modbus protocol. The Modbus address mapping with I/O is described as the followings.

Output Status for Digital Output

NAME	ADDRESS	EXPLAN	Write/Read
DO1	00001	DO1 status 0 = off 1 = on	01 function: Read Coil Status
DO2	00002	DO2 status 0 = off 1 = on	05 function: Write Single Coil 0F function: Write Multiple Coil

Analogue Input status

Every analog input signal of PL-ATS is read only and is used by two ways, Input Status and Holding Registers. In Input Status functions, it is acceptable using 0x02 (Read Input Status) to check the status of inputs. According to the Input Status, Bit0 ~ Bit7 (**10001 ~ 10008**) indicates the underflow of the input of Mode2(1~5V) and Mode4(4~2mA), which means when the input voltage is lower than 1V under Mode2 or input current is lower than 4mA under Mode4 then corresponded bit will be set to '1'. Bit8 ~ Bit15 (**10009 ~10016**) indicates the overflow of the input of all modes, which means when the input voltage is higher than 10V in Mode1, and 5V in Mode2 or the input current is higher than 20mA in Mode3 and Mode4, the corresponded bit will be set to '1'. All the 16 bit will be mapped onto the holding register of **40012** (Line Broken Detection Flags).

ADDRESS	EXPLAN	SET	Write/Read
10001	Analogue Input 1 lower than 1V or 4 mA	1	02 function.:R
10002	Analogue Input 2 lower than 1V or 4 mA	1	02 function.:R
10003	Analogue Input 3 lower than 1V or 4 mA	1	02 function.:R
10004	Analogue Input 4 lower than 1V or 4 mA	1	02 function.:R
10005	Analogue Input 5 lower than 1V or 4 mA	1	02 function.:R
10006	Analogue Input 6 lower than 1V or 4 mA	1	02 function.:R
10007	Analogue Input 7 lower than 1V or 4 mA	1	02 function.:R
10008	Analogue Input 8 lower than 1V or 4 mA	1	02 function.:R
10009	Analogue Input 1 higher than 5V or 20 mA	1	02 function.:R
10010	Analogue Input 2 higher than 5V or 20 mA	1	02 function.:R
10011	Analogue Input 3 higher than 5V or 20 mA	1	02 function.:R
10012	Analogue Input 4 higher than 5V or 20 mA	1	02 function.:R
10013	Analogue Input 5 higher than 5V or 20 mA	1	02 function.:R
10014	Analogue Input 6 higher than 5V or 20 mA	1	02 function.:R
10015	Analogue Input 7 higher than 5V or 20 mA	1	02 function.:R
10016	Analogue Input 8 higher than 5V or 20 mA	1	02 function.:R

Analogue Input Signal

Besides Input Status, Input Registers stand for the value of the analog input. Using 0x04 (Read Input Registers) function could let the user grab the input value of the channels. The address is at **30001 ~ 30008**. The same we can use Holding Register to obtain the information. The Holding Register Address is at **40001 ~ 40008**. All these registers are 2 byte long in length. The Input Registers show the raw data on each channel, however, Holding Register of **40013** is a "Conversion Data Type" which controls the display type of the channels. Bit0~Bit7 of 40013 control the corresponded channel, so that the channel will show an engineering data or a raw data.

ADDRESS	EXPLAN	RANGE	Write/Read
30001	The data of Analogue Input 1	0~65535	04 function:R
30002	The data of Analogue Input 2	0~65535	04 function:R
30003	The data of Analogue Input 3	0~65535	04 function:R
30004	The data of Analogue Input 4	0~65535	04 function:R
30005	The data of Analogue Input 5	0~65535	04 function:R
30006	The data of Analogue Input 6	0~65535	04 function:R
30007	The data of Analogue Input 7	0~65536	04 function:R
30008	The data of Analogue Input 8	0~65536	04 function:R

Holding Register

ADDRESS	EXPLAN	RANGE	Write/Read
40001	Engineer Value of AI1		03 function: R
40002	Engineer Value of AI2		03 function: R
40003	Engineer Value of AI3		03 function: R
40004	Engineer Value of AI4		03 function: R
40005	Engineer Value of AI5		03 function: R
40006	Engineer Value of AI6		03 function: R
40007	Engineer Value of AI7		03 function: R
40008	Engineer Value of AI8		03 function: R
40009	Limitation Status[*1]		03 function: R
40010	Function Status[*7]		03 function: R
40011	Input Mode[*9]		03 function: R
40012	Exceed Input Range		03 function: R
40013	Conversion Data Type control[*5]		03 fun.: R 06 fun.: Single R 10 fun.: Multiple W
40014	Limitation Control Flag[*2]		W/R
40015	Digital Output		W/R
40016	Device ID[*10]		R
40017	Baud Rate		R
40018	Function Execution[*8]		W/R
40019	User Defined Register		W/R
40020	User Defined Register		W/R
40021	CH1 Low Limitation[*3]		W/R
40022	CH2 Low Limitation[*3]		W/R
40023	CH3 Low Limitation[*3]		W/R
40024	CH4 Low Limitation[*3]		W/R
40025	CH5 Low Limitation[*3]		W/R
40026	CH6 Low Limitation[*3]		W/R
40027	CH7 Low Limitation[*3]		W/R
40028	CH8 Low Limitation[*3]		W/R
40029	User Defined Register		W/R
40030	User Defined Register		W/R
40031	CH1 High Limitation[*4]		W/R
40032	CH2 High Limitation[*4]		W/R
40033	CH3 High Limitation[*4]		W/R
40034	CH4 High Limitation[*4]		W/R
40035	CH5 High Limitation[*4]		W/R
40036	CH6 High Limitation[*4]		W/R
40037	CH7 High Limitation[*4]		W/R
40038	CH8 High Limitation[*4]		W/R
40039	User Defined Register		W/R
40040	User Defined Register		W/R
40041	CH1 Engineering Low[*6]		W/R
40042	CH2 Engineering Low[*6]		W/R
40043	CH3 Engineering Low[*6]		W/R
40044	CH4 Engineering Low[*6]		W/R
40045	CH5 Engineering Low[*6]		W/R
40046	CH6 Engineering Low[*6]		W/R
40047	CH7 Engineering Low[*6]		W/R
40048	CH8 Engineering Low[*6]		W/R
40049	User Defined Register		W/R
40050	User Defined Register		W/R
40051	CH1 Engineering High[*6]		W/R
40052	CH2 Engineering High[*6]		W/R
40053	CH3 Engineering High[*6]		W/R
40054	CH4 Engineering High[*6]		W/R
40055	CH5 Engineering High[*6]		W/R
40056	CH6 Engineering High[*6]		W/R
40057	CH7 Engineering High[*6]		W/R
40058	CH8 Engineering High[*6]		W/R
40059	User Defined Register		W/R
40060	User Defined Register		W/R

*1

40009: The limitation indicator of the whole limitation control.
(Limitation Status)
Bit0 ~ Bit7 indicate if the input value is lower than the lower limitation to the corresponded channels.
Bit8 ~ Bit15 indicate if the input value is higher than the upper limitation to the corresponded channels.
If the condition matched, the corresponded bit of 40009 is set to '1'.
Bit 0:   low limitation flag of channel 1
Bit 1:   high limitation flag of channel 1
Bit 2:   low limitation flag of channel 2
Bit 3:   high limitation flag of channel 2
Bit 4:   low limitation flag of channel 3
Bit 5:   high limitation flag of channel 3
Bit 6:   low limitation flag of channel 4
Bit 7:   high limitation flag of channel 4
Bit 8:   low limitation flag of channel 5
Bit 9:   high limitation flag of channel 5
Bit 10:   low limitation flag of channel 6
Bit 11:   high limitation flag of channel 6
Bit 12:   low limitation flag of channel 7
Bit 13:   high limitation flag of channel 7
Bit 14:   low limitation flag of channel 8
Bit 15:   high limitation flag of channel 8

*2

40014: The Limitation Control Register.
(High/Low Limitation Control Flags)
If Bit0 ~ Bit7 is set to '1', Holding Register of 40009 will be enabled to check the part of low limitation comparison on each corresponded channel. If not, it is disabled.
If Bit8 ~ Bit15 is set to '1', Holding Register of 40009 will be enabled to check the part of high limitation comparison on each corresponded channel. If not, it is disabled.
Bit 0:   low limitation control bit for CH1
Bit 1:   high limitation control bit for CH1
Bit 2:   low limitation control bit for CH2
Bit 3:   high limitation control bit for CH2
Bit 4:   low limitation control bit for CH3
Bit 5:   high limitation control bit for CH3
Bit 6:   low limitation control bit for CH4
Bit 7:   high limitation control bit for CH4
Bit 8:   low limitation control bit for CH5
Bit 9:   high limitation control bit for CH5
Bit 10:   low limitation control bit for CH6
Bit 11:   high limitation control bit for CH6
Bit 12:   low limitation control bit for CH7
Bit 13:   high limitation control bit for CH7
Bit 14:   low limitation control bit for CH8
Bit 15:   high limitation control bit for CH8

*3

40021 ~ 40028 refers to the low limitation of the corresponded channels.
40021 is Limitation Lower Bound of Channel 1
40022 is Limitation Lower Bound of Channel 2
40023 is Limitation Lower Bound of Channel 3
40024 is Limitation Lower Bound of Channel 4
40025 is Limitation Lower Bound of Channel 5
40026 is Limitation Lower Bound of Channel 6
40027 is Limitation Lower Bound of Channel 7
40028 is Limitation Lower Bound of Channel 8

*4

40031 ~ 40038 refers to the high limitation of the corresponded channels.
40031 is Limitation Upper Bound of Channel 1
40032 is Limitation Upper Bound of Channel 2
40033 is Limitation Upper Bound of Channel 3
40034 is Limitation Upper Bound of Channel 4
40035 is Limitation Upper Bound of Channel 5
40036 is Limitation Upper Bound of Channel 6
40037 is Limitation Upper Bound of Channel 7
40038 is Limitation Upper Bound of Channel 8

*5 Conversion Data Type Control

Engineering Data Mapping:
Every channel of PL-ATS could make an engineering mapping, so that the input value of each channel could be transformed onto the interval of the engineering mapping. Holding Register 40013 decides such the control to enable or disable this kind of engineering mapping in bit level. It means that Bit0~Bit7 enable the mapping by setting to '1' to the corresponded channel, and Bit8~Bit15 is now reserved. The low scale of the interval to each channel is set by Holding Registers 40041 ~ 40048, while the high scale of the

interval to each channel is set by Holding Registers 40051 ~ 40058. User could define the low and high scale by themselves so the engineering data could make the conversion complete.
Bit0 ~ Bit7 are Engineering Mapping Control Flags.
'0': Disable Engineering Mapping.
'1': Enable Engineering Mapping.
Bit8 ~ Bit15 is reserved.
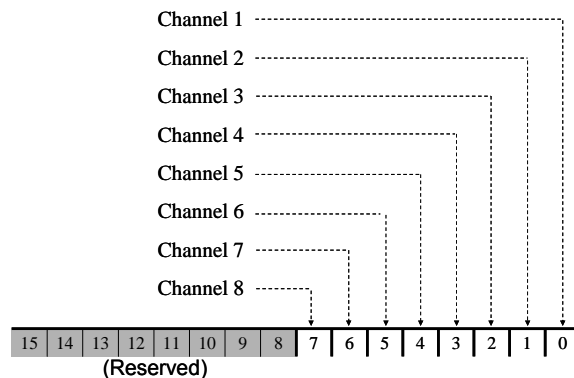
*6 Conversion Data Type Control

40041 ~ 40048 refers to the lower bound of the engineering mapping to the corresponded channels.
40041 is Engineering Mapping Low Scale of Channel 1
40042 is Engineering Mapping Low Scale of Channel 2
40043 is Engineering Mapping Low Scale of Channel 3
40044 is Engineering Mapping Low Scale of Channel 4
40045 is Engineering Mapping Low Scale of Channel 5
40046 is Engineering Mapping Low Scale of Channel 6
40047 is Engineering Mapping Low Scale of Channel 7
40048 is Engineering Mapping Low Scale of Channel 8

40051 ~ 40058 refers to the upper bound of the engineering mapping to the corresponded channels.
40051 is Engineering Mapping High Scale of Channel 1
40052 is Engineering Mapping High Scale of Channel 2
40053 is Engineering Mapping High Scale of Channel 3
40054 is Engineering Mapping High Scale of Channel 4
40055 is Engineering Mapping High Scale of Channel 5
40056 is Engineering Mapping High Scale of Channel 6
40057 is Engineering Mapping High Scale of Channel 7
40058 is Engineering Mapping High Scale of Channel 8

Saving Data:
User can use Holding Register 40018 to save the value. All the data of address from 40013 to 40060 could save into flash and got back after the next power reset if we write 0xAAAA a hex number to 40018. The Holding Register 40010 will show the status for the 0xAAAA writing. It will show in a loop from 0xAAAA, 0xBBBB, 0xCCCC, 0xDDDD, and 0xEEEE, and then go back to 0xAAAA after the next 0xAAAA command written again to 40018. A hex number of 0xFFFF written to 40018 will restore all the default factory value of Holding Registers from 40013 to 40060 and 40010 will be reset 0.

*7

40010: Function Execution Status Register.
Read Only
Value: 0x0000, 0xAAAA, 0xBBBB, 0xCCCC, 0xDDDD, 0xEEEE

*8

40018: Function Execution Register.
0xAAAA: Save the Data.
0xFFFF: Restore Default Factory Value from 40013 to 40060.

*9

40011: Input Range Mode
Mode1: 0V – 10V   Mode2: 1V – 5V
Mode3: 0mA – 20mA   Mode4: 4mA – 20mA

*10

40016: Device ID for Modbus
If DIP Device ID is not 0, it won't do any effect of Device ID.
If DIP Device ID is 0, than 40016 could be set and saved.

*11

40017: Device ID Control for Modbus
Enable: 1 ; PL-ATS will reply the request only when the Device ID is correct.
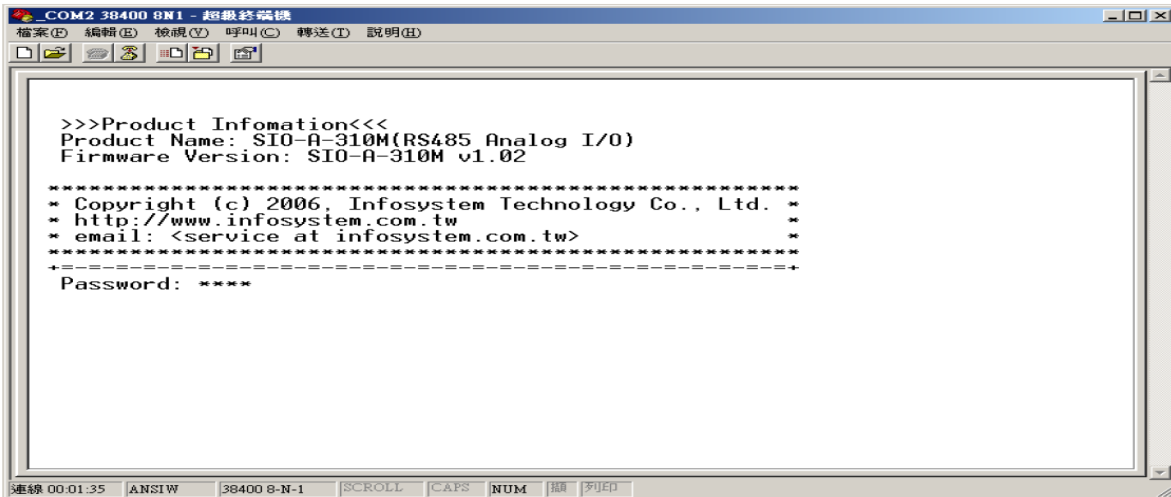Disable: 0 ; PL-ATS will reply all valid request without Device ID check.

■ Console Mode Description

– HyperTerminal Connection Screen Shot 1 –

Note:

Console Mode is statically configured as 38400, 8, N, 1, and Flow Control is none.
The Connection of HyperTerminal is as the following:

Default Password is 【1234】
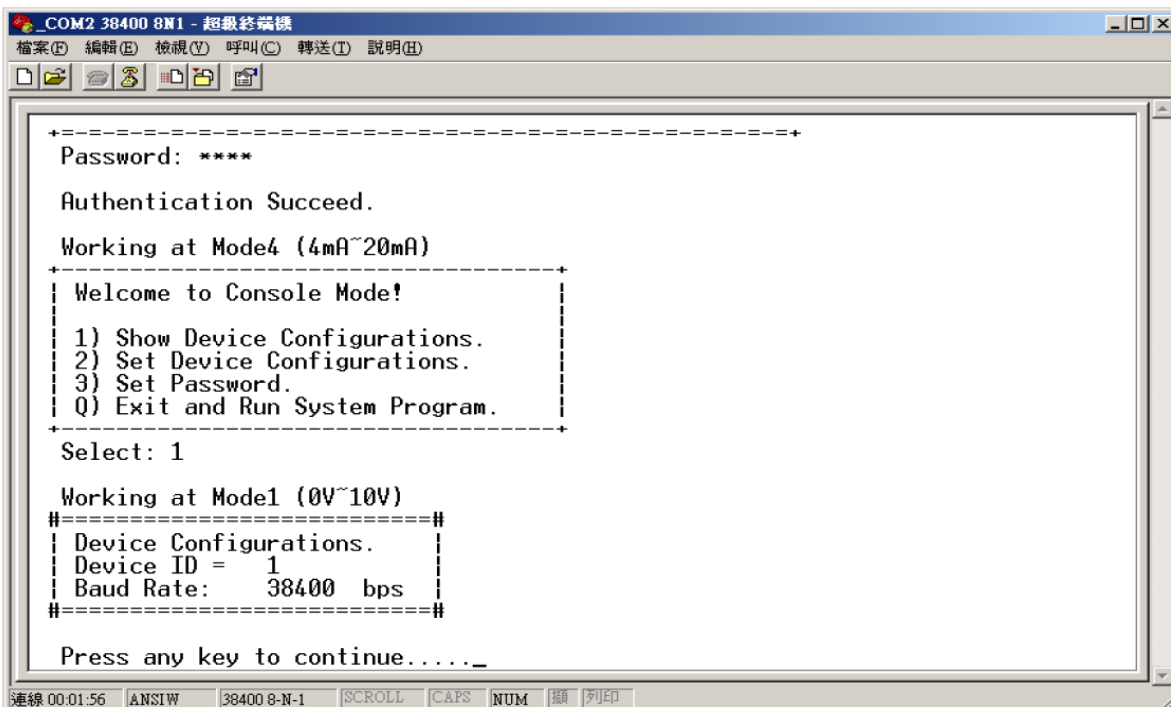
```
_COM2 38400 8N1 - 超級終端機                                        _ □ ×
檔案(F)  編輯(E)  檢視(V)  呼叫(C)  轉送(T)  說明(H)

  >>>Product Infomation<<<
  Product Name: SIO-A-310M(RS485 Analog I/O)
  Firmware Version: SIO-A-310M v1.02

  ************************************************************
  * Copyright (c) 2006, Infosystem Technology Co., Ltd. *
  * http://www.infosystem.com.tw                         *
  * email: <service at infosystem.com.tw>                *
  ************************************************************
  +=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-+
  Password: ****



連線 00:01:35   ANSIW      38400 8-N-1    SCROLL   CAPS   NUM   擷  列印
```

[Figure. Main Menu]

– HyperTerminal Connection Screen Shot 2 –

```
_COM2 38400 8N1 - 超級終端機                                        _ □ ×
檔案(F)  編輯(E)  檢視(V)  呼叫(C)  轉送(T)  說明(H)

  +=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-+
  Password: ****

  Authentication Succeed.

  Working at Mode4 (4mA~20mA)
  +----------------------------------------+
  | Welcome to Console Mode!               |
  |                                        |
  | 1) Show Device Configurations.         |
  | 2) Set Device Configurations.          |
  | 3) Set Password.                       |
  | Q) Exit and Run System Program.        |
  +----------------------------------------+
  Select: 1

  Working at Mode1 (0V~10V)
  #==========================#
  | Device Configurations.   |
  | Device ID =    1         |
  | Baud Rate:    38400  bps |
  #==========================#

  Press any key to continue....._

連線 00:01:56   ANSIW      38400 8-N-1    SCROLL   CAPS   NUM   擷  列印
```

[Figure. Show Device Configurations.]

– HyperTerminal Connection Screen Shot 3 –


```
Working at Mode4 (4mA~20mA)
+--------------------------------------+
| Welcome to Console Mode!             |
|                                      |
| 1) Show Device Configurations.       |
| 2) Set Device Configurations.        |
| 3) Set Password.                     |
| Q) Exit and Run System Program.      |
+--------------------------------------+
Select: 2


Current Configuration...
Working at Mode1 (0V~10V)
#============================#
| Device Configurations.     |
| Device ID =    1           |
| Baud Rate:     38400  bps  |
#============================#

-=#[ Setting Device ID ]#=-
Range: 0 < Device ID < 256
Input Device ID: 1_
```
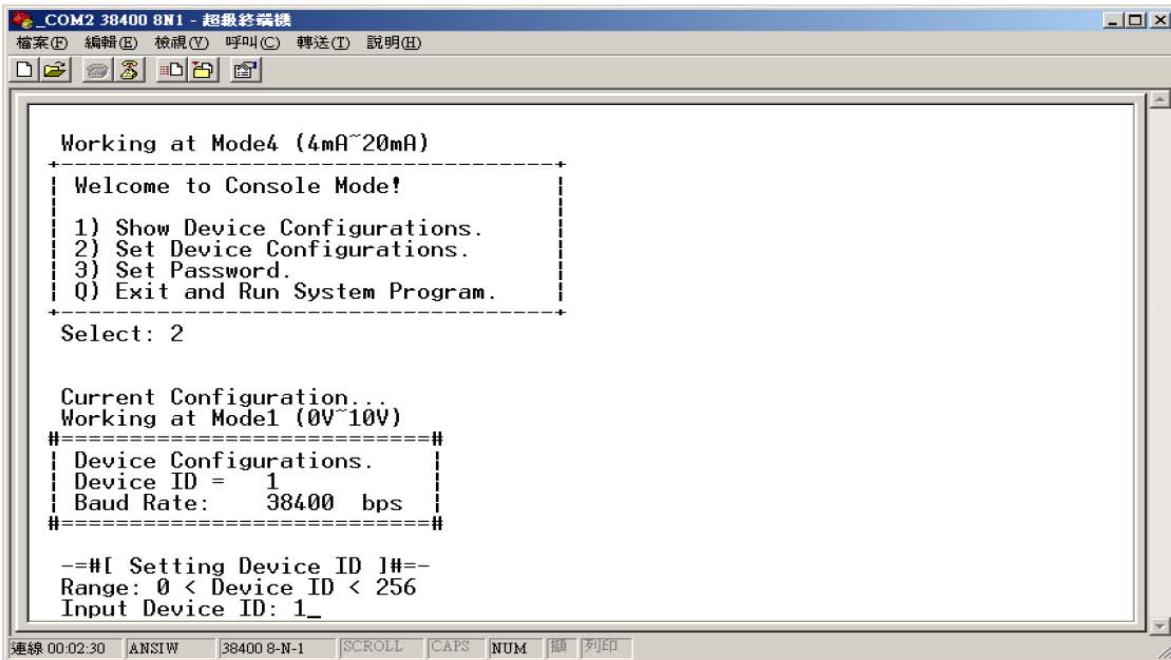
[Figure. Set Device Configuration 1.]

– HyperTerminal Connection Screen Shot 4 –


```
Current Configuration...
Working at Mode1 (0V~10V)
#============================#
| Device Configurations.     |
| Device ID =    1           |
| Baud Rate:     38400  bps  |
#============================#

-=#[ Setting Device ID ]#=-
Range: 0 < Device ID < 256
Input Device ID: 1

-=#[ Setting Baud Rate ]#=-
(1)    2400 bps
(2)    4800 bps
(3)    9600 bps
(4)   14400 bps
(5)   19200 bps
(6)   38400 bps
(7)   57600 bps
(8)  115200 bps
Select: 6

Are you sure (Y/N)?
```

[Figure. Set Device Configurations 2.]

PL-ATS

– HyperTerminal Connection Screen Shot 5 –


```
COM2 38400 8N1 - 超級終端機
檔案(F) 編輯(E) 檢視(V) 呼叫(C) 轉送(T) 說明(H)

| Device Configurations.      |
| Device ID =    1            |
| Baud Rate:     38400  bps   |
#============================#

 Press any key to continue.....

 Working at Mode4 (4mA~20mA)
+------------------------------------+
| Welcome to Console Mode!           |
|                                    |
| 1) Show Device Configurations.     |
| 2) Set Device Configurations.      |
| 3) Set Password.                   |
| Q) Exit and Run System Program.    |
+------------------------------------+
 Select: 3

 Changing Password.
 New Password:****
 Retype New Password:****
 New Password Saved!

 Press any key to continue......_

連線 00:03:20   ANSIW     38400 8-N-1    SCROLL   CAPS   NUM   顯  列印
```

[Figure. Set Password.]

– HyperTerminal Connection Screen Shot 6 –


```
COM2 38400 8N1 - 超級終端機
檔案(F) 編輯(E) 檢視(V) 呼叫(C) 轉送(T) 說明(H)

 Changing Password.
 New Password:****
 Retype New Password:****
 New Password Saved!

 Press any key to continue.....

 Working at Mode4 (4mA~20mA)
+------------------------------------+
| Welcome to Console Mode!           |
|                                    |
| 1) Show Device Configurations.     |
| 2) Set Device Configurations.      |
| 3) Set Password.                   |
| Q) Exit and Run System Program.    |
+------------------------------------+
 Select: q

 Exit and Run System Program.

 Finished. Please reboot SIO-A-310M(RS485 Analog I/O).

Version: SIO-A-310M v1.02

連線 00:10:40   ANSIW     38400 8-N-1    SCROLL   CAPS   NUM   顯  列印
```

[Figure. Exit and Run System Program.]