

I-8024W/I-9024

I/O Module User Manual

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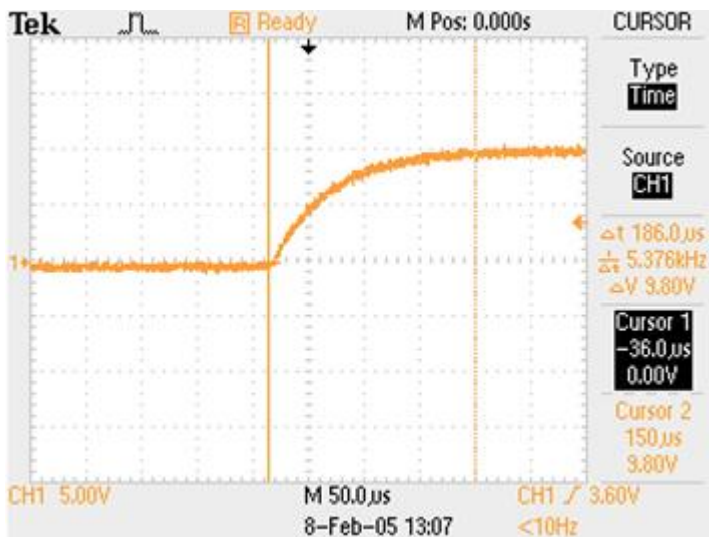
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1. Introduction

I-8024W/I-9024 is a 14-bit analog output module, there are 4 single-ended analog output channels. Every channel can be programmed to an individual output range of, ± 10 V or $0 \sim +20$ mA.

The I-8024W/I-9024 provide RF immunity level matching that defined by IEC 61000-4-3 standard, together with 4 kV ESD protection as well as 3000 VDC intra-module isolation.

The slew rate of output voltage is about 0.72 V/ μ s, shown as below.



Applicable Platform table

The following table shows which platform the module applies to.

Platform	OS	Module
XPAC	XP-8000(WES)	I-8024W
	XP-8000-Atom (WES)	I-8024W
	XP-8000-WES7 (WES7)	I-8024W
	XP-8000-CE6 (WinCE 6.0)	I-8024W
	XP-8000-Atom-CE6 (WinCE 6.0)	I-8024W
	XP-9000-WES7 (WES7)	I-9024
WinPAC	WP-8000 (CE 5.0/7.0)	I-8024W
	WP-9000-CE7 (CE 7.0)	I-9024
LinPAC	LinPAC-8000 (Linux kernel 3.2/4.4)	I-8024W
	LinPAC-9000 (Linux Kernel 3.2/4.4)	I-9024
IPAC	iPAC-8000 (MiniOS7)	I-8024W
	I-8000 (MiniOS7)	I-8024W

Tips & Warnings



I-8024W / I-9024 are different from I-8024UW / I-8028UW / I-9024U / I-9028U.

There are SDKs provided each series modules.

1.1. Specifications

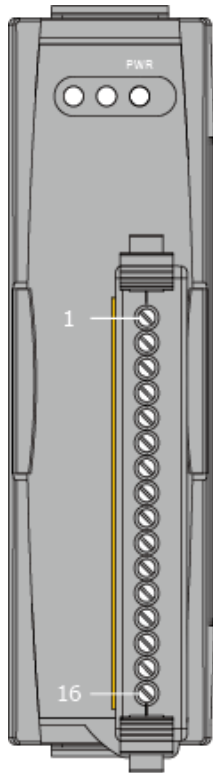
Analog Output		I-8024W	I-9024
Channels		4	
Current Output Wiring		Sink	
Range		+/- 10V, 0 ~ +20 mA	
Resolution		14-bit	
Accuracy	Voltage	+/- 0.1% of FSR	
	Current	+/- 0.2% of FSR	
Readback Accuracy		+/-1% of FSR	
Zero Drift	Voltage	+/-30 μ V/ $^{\circ}$ C	
	Current	+/-0.2 μ A/ $^{\circ}$ C	
Span Drift		+/- 20ppm/ $^{\circ}$ C	
Response Time		25 us per channel	
Slew Rate	Voltage	0.72 V/us	
	Current	0.107 mA/us	
Voltage Output Capability		10 V @ 20 mA	
Max Current Load Resistance		External +24V : 1050 Ohms	
LED Indicators			
System LED Indicator		1 LED as Power/Communication Indicator	
Isolation			
Intra-module Isolation, Field to Logic		3000 VDC	
EMS Protection			

ESD (IEC 61000-4-2)	±4 kV Contact for each Terminal	±4 kV Contact for each Terminal ±8 kV Air for Random Point
---------------------	---------------------------------	---

Power		
Power Consumption	2 W Max.	
Mechanical		
Dimensions (L x W x H)	30 mm x 102 mm x 115 mm	144 mm x 31 mm x 134 mm
Environment		
Operating Temperature	-25 ~ +75°C	
Storage Temperature	-30 ~ +80°C	-40 ~ +85 °C
Humidity	10 ~ 90% RH, Non-condensing	

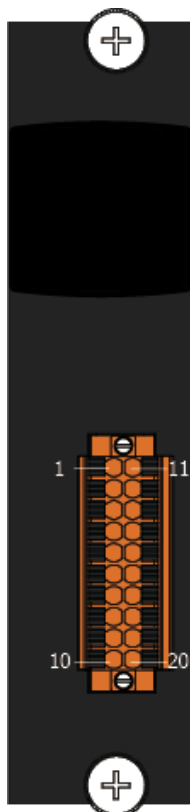
1.2. Pin Assignments

I-8024W



Terminal No.	Pin Assignment
01	Iout0
02	AGND
03	Iout1
04	AGND
05	Iout2
06	AGND
07	Iout3
08	AGND
09	Vout0
10	AGND
11	Vout1
12	AGND
13	Vout2
14	AGND
15	Vout3
16	AGND

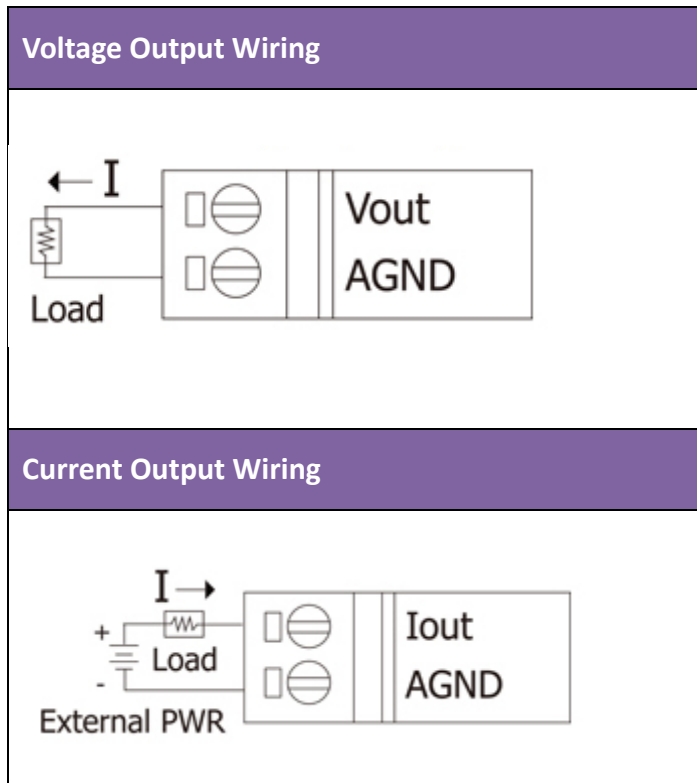
I-9024



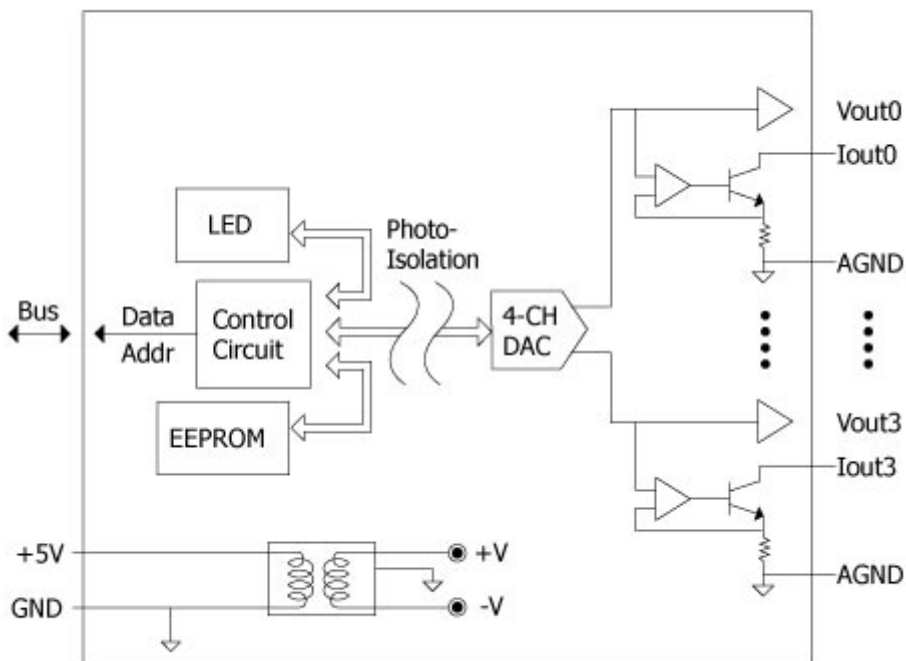
Pin Assignment	Terminal No.	Pin Assignment
VO0	01	I0
AGND	02	AGND
VO1	03	I1
AGND	04	AGND
VO2	05	I2
AGND	06	AGND
VO3	07	I3
AGND	08	AGND
-	09	-
FG	10	FG

20-pin Connector

1.3. Wire Connections



1.4. Block Diagram



2. Quick Start

This chapter will be accompanied by demos to explain how to implement functions.

Demos can be downloaded in the following link:

<https://www.icpdas.com/en/download/show.php?num=2898>

2.1. MiniOS7-based Controllers

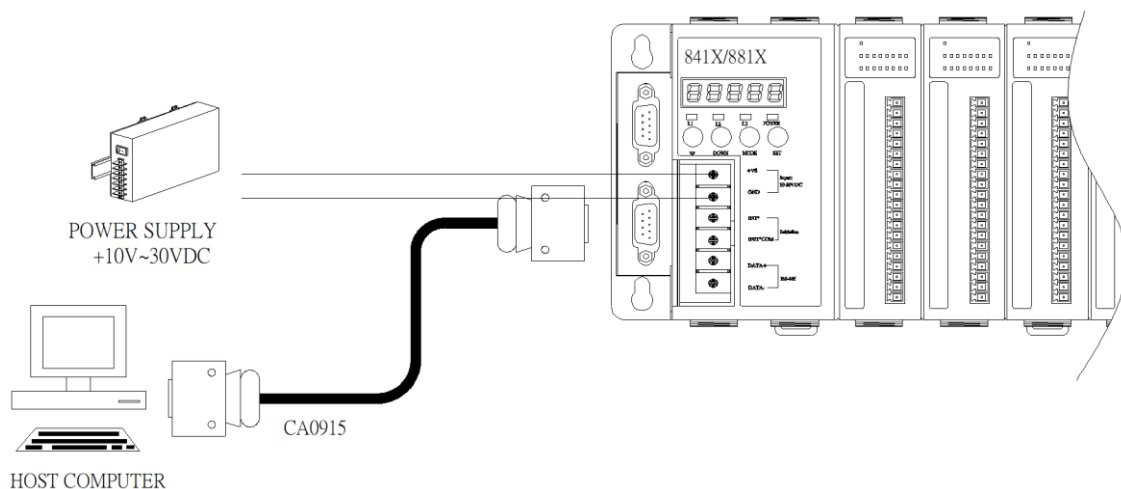
2.1.1. Basic Function

Basic function can be used to retrieve configuration information and verify the AO output function.

The following steps show how to test I-8024W in MiniOS7 controller.

Step 1: Please refer to the “Wire Connections”

Step 2: Plug I-8024W in the MiniOS7 controller, connect the power supply to the unit and connect the unit to the Host PC by RS-232 cable



Step 3: Run 7188xw.exe on the host PC and open the COM Port which is connecting to the MiniOS7 Controller

Tips & Warnings



7188xw.exe is an interface for PC, it can help users to communicate with MiniOS7 PAC, please refer to the MiniOS7 PAC user manual for more detail.

Step 4: Run the demo and then verify the basic functions

```
> 7188XW 1.31 [COM1:115200,N,8,1],FC=0,CTS=1, DIR=F:\edward_ku\t
C837_V2_UDP>8024DEMO.EXE
/*****
/*      8024 demo      */
/*                               */
/* [7,Oct,2004]      */
/*****
Slot(0~3 or 0~7)=2
Channel(0~3)=0
Mode
0) Voltage +/- 10.0 V          (float format)
1) Current 0 ~ 20 mA          (float format)
2) Voltage +/- 10.0 V          (2's format)
3) Current 0 ~ 20 mA          (2's format)
4) Voltage +/- 10000 (mV)      (integer format)
5) Current 0 ~ 20000 (0.001 mA)(integer format)
Please choose(0~5):0
Output Voltage(+/- 10.0)(unit: V) = 10
Press 'q' or 'Q' to quit, other key to continue...
```



2.2. Windows-based Controllers

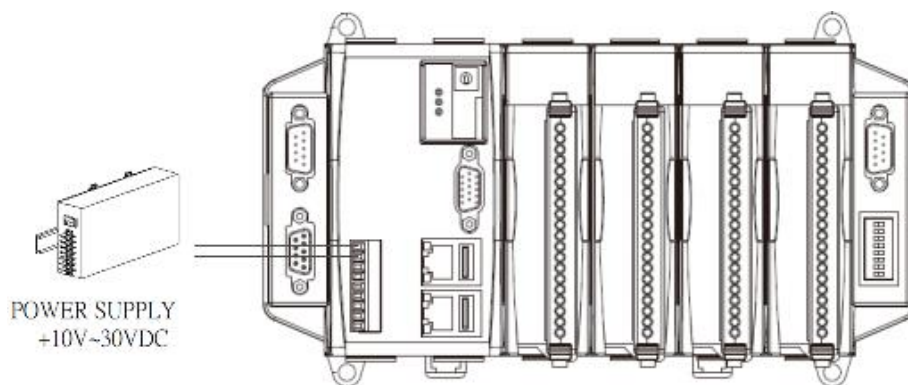
2.2.1. Basic Function

Basic function can be used to retrieve configuration information and verify the AO output function

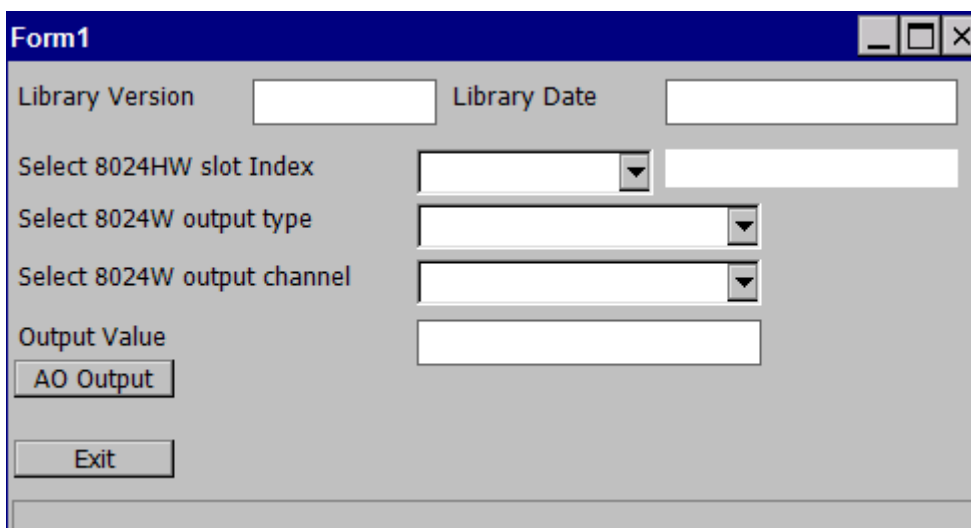
The following steps show how to test I-8024W in CE or WES controller.

Step 1: Please refer to the “Wire Connections”, I-8024W to voltage meter or current meter.

Step 2: Plug I-8024W in the Windows-based controller and connect the power supply to the unit.



Step 3: Run the demo and then verify the basic functions.

A screenshot of a software application window titled 'Form1'. The window has a blue title bar with standard minimize, maximize, and close buttons. The main area is light gray and contains several input fields and buttons. At the top, there are two text boxes labeled 'Library Version' and 'Library Date'. Below these are three dropdown menus: 'Select 8024HW slot Index', 'Select 8024W output type', and 'Select 8024W output channel'. Underneath the dropdowns is a text box labeled 'Output Value'. At the bottom left, there are two buttons: 'AO Output' and 'Exit'. The window also has a status bar at the very bottom.

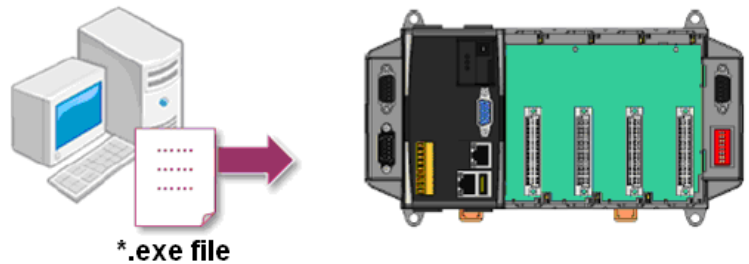
2.3. Linux-based Controllers

2.3.1. Basic Function

Basic function can be used to retrieve configuration information and verify the AO output function.

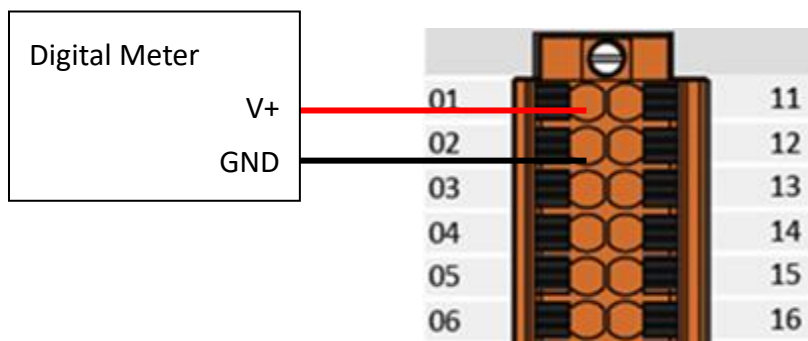
Basic information includes:

- The data output for each channel



Please follow the steps below to learn how to use I-8024W/I-9024.

1. Users need to download LinPAC SDK, which includes GNU tool chain, Libraries, header, examples files, etc.
2. Check the power cable, Ethernet cable, VGA monitor, the communication cable between controller and PC has been connected well, and then check the I-8024W/I-9024 has been plugged in the controller.
3. I-8024 doesn't support Hot plugging, please make sure the module plugged on the host before turn on the PAC.
4. Connect to the device (e.g., Digital Meter) by the Single-ended wiring method, as illustrated below.



- Next, check the communication between controller and PC is fine, and download the demo program files to the controller.

The following is a list of the locations where both the demo programs and associated libraries (libi8k.a) can be found on either the ICP DAS web site, and user can find the related files in the below website:

PRRODUCT	CPU	DOWNLOAD LINK
LP-8x4x	PXA270	https://www.icpdas.com/en/download/show.php?num=982
LP-8x2x/LP-9x2x	AM335x	https://www.icpdas.com/en/download/show.php?num=915
LX-8000/9000	X86/E38xx	https://www.icpdas.com/en/download/show.php?num=904

3. API References

ICPDAS supplies a range of C/C++ API functions for I-8024W and I-9024 modules.

When developing a program, refer to either the 8017HW.h header file, or the API functions described in the following sections for more detailed information.

ICPDAS also supplies a range of C# function that can be used to develop .NET programs, these functions are ported from the relevant C/C++ functions.

Download link : <https://www.icpdas.com/en/download/show.php?num=2898>

API Naming Table

The following table shows the API names on different platforms and the beginning of API.

Platform	Product included	API prefix characters	
		C / C++	C#
CE5.0	I-8024W	"pac_i8024W_" + function name	"pac8024WNet.pac8024W" + function name
CE6.0	I-8024W		
CE7.0	I-8024W/I-9024		
WES	I-8024W/I-9024		
MiniOS7	I-8024W	"i8024_" + function name	Null
Linux	I-8024W	"i8024_" + function name	
	I-9024	"i8024_" + function name	

The following table lists the functions provided in 8024.lib and pac_8024W.lib.

API	Description
I8024_Initial pac_i8024W_Initial	Used to initialize the module
I8024_VoltageOut pac_i8024W_VoltageOut	This function makes I-8024W/I-9024 modules to output the voltage of specified floating-point value in the specified channel and slot.
I8024_CurrentOut pac_i8024W_CurrentOut	This function makes I-8024W/I-9024 modules to output the current of specified floating-point value in the specified channel and slot.
I8024_VoltageOut_Hex pac_i8024W_VoltageOut_Hex	This function makes I-8024WI-9024 modules to output the specified voltage value in HEX format in the specified channel and slot.
I8024_CurrentOut_Hex pac_i8024W_CurrentOut_Hex	This function makes I-8024W/I-9024 modules to output the specified current value in HEX format in the specified channel and slot.

3.1. I8024_Initial / pac_i8024W_Initial

This function is used to initialize the module, and must be called at least once before using any other function.

Syntax

For MiniOS7

```
void I8024_Initial(int Slot);
```

For Windows

```
short pac_i8024W_Initial(int Slot);
```

For Linux

```
void I8024_Init(int slot);           // for LinPAC-8000  
void i9024_Init(int slot);         // for LinPAC-9000, LX-9000
```

Parameters

slot:

Specific slot number (0 - 7), except range of slot is number 1 ~ 8 for LinPAC.

Return Values

Refer to Appendix A: “Error Code” for more details.

Examples

[C++]

```
int slot;  
i8024W_Init(slot);
```

[C#]

```
int slot;  
pac8024W.Init(slot);
```

[C] (For LinPAC)

```
int main(){  
    int slot, ret;  
    ret=Open_Slot(slot);  
    if (ret > 0) {  
        printf("Open Slot%d failed, return value=%d \n", slot, ret);  
        return (-1);  
    }  
  
    I8024_Init(slot);  
    Close_Slot(slot);  
    return 0;  
}
```

3.2. I8024_VoltageOut / pac_i8024W_VoltageOut

This function makes the module output a voltage value of specified floating-point.

Syntax

For MiniOS7

```
void I8024_VoltageOut(int slot,int ch,float fData);
```

For Windows (CE and WES)

```
void pac_i8024W_VoltageOut(int slot,int ch,float fData);
```

For Linux

```
void I8024_VoltageOut(int slot,int ch,float fData);           // for LinPAC-8000  
void I9024_VoltageOut(int slot,int ch,float fData);           // for LinPAC-9000, LX-9000
```

Parameter

slot [in]

Specific slot number (0 - 7), except range of slot is number 1 ~ 8 for LinPAC.

ch [in]

Specifies the channel number(0 to 3).

fData[in]

Specifies the analog output value in float format (Voltage range: -10 ~ +10V).

Return Values

None.

Examples

[C++]

```
int slot , ch ;  
float data ;  
I8024_VoltageOut(slot, ch, data);
```

[C#]

```
int slot, ch;  
float data;  
pac8024W.VoltageOut(slot, ch, data);
```

[C] (For LinPAC)

```
int main(){  
    int slot, ch,ret;  
    float data;  
    ret=Open_Slot(slot);  
    if (ret > 0) {  
        printf("Open Slot%d failed, return value=%d \n", slot, ret);  
        return (-1);  
    }  
  
    I8024_Init(slot);  
    I8024_VoltageOut(slot, ch, data);  
    Close_Slot(slot);  
    return 0;  
}
```

3.3. I8024_CurrentOut / pac_i8024W_CurrentOut

This function makes the module to output a current value of specified floating-point.

Syntax

For MiniOS7

```
void I8024_CurrentOut(int slot, int ch, float fData);
```

For Windows (CE and WES)

```
void pac_i8024W_CurrentOut(int slot, int ch, float fData);
```

For Linux

```
void I8024_CurrentOut (int slot, int ch, float fData);           // for LinPAC-8000  
void i9024_CurrentOut (int slot, int ch, float fData);         // for LinPAC-9000, LX-9000
```

Parameter

slot [in]

Specific slot number (0 - 7), except range of slot is number 1 ~ 8 for LinPAC.

ch [in]

Specifies the channel number(0 to 3).

fData[in]

Specifies the analog output value in float format (Current range: 0 ~ + 20 mA).

Return Values

None

Examples

[C++]

```
int slot , ch ;  
float data;  
I8024_CurrentOut(slot, ch, data);
```

[C#]

```
int slot, ch;  
float data;  
pac8024W.CurrentOut(slot, ch, data);
```

[C] (For LinPAC)

```
int main(){  
    int slot, ch,ret;  
    float data;  
    ret=Open_Slot(slot);  
    if (ret > 0) {  
        printf("Open Slot%d failed, return value=%d \n", slot, ret);  
        return (-1);  
    }  
  
    I8024_Init(slot);  
    I8024_CurrentOut (slot, ch, data);  
    Close_Slot(slot);  
    return 0;  
}
```

3.4. I8024_VoltageOut_Hex / pac_i8024W_VoltageOut_Hex

This function makes the module to output the specified voltage value in HEX format.

Syntax

For MiniOS7

```
void I8024_VoltageOut_Hex(int slot, int ch, int hData);
```

For Windows (CE and WES)

```
void pac_i8024W_VoltageOut_Hex(int slot, int ch, int hData);
```

For Linux

```
void I8024_VoltageOut_Hex (int slot, int ch, int hData);           // for LinPAC-8000  
void i9024_VoltageOut_Hex (int slot, int ch, int hData);         // for LinPAC-9000, LX-9000
```

Parameter

slot [in]

Specific slot number (0 - 7), except range of slot is number 1 ~ 8 for LinPAC.

ch [in]

Specifies the channel number(0 to 3).

hData [in]

Specifies the analog output value in hexadecimal format (8000h ~ 7FFFh).

Return Values

None

Examples

[C++]

```
int slot, ch, data;  
I8024_VoltageOut_Hex(slot, ch, data);
```

[C#]

```
int slot, ch, data;  
pac8024W.VoltageOut_Hex (slot, ch, data);
```

[C] (For LinPAC)

```
int main(){  
    int slot, ch, data ,ret;  
    ret=Open_Slot(slot);  
    if (ret > 0) {  
        printf("Open Slot%d failed, return value=%d \n", slot, ret);  
        return (-1);  
    }  
  
    I8024_Init(slot);  
    I8024_VoltageOut_Hex (slot, ch, data);  
    Close_Slot(slot);  
    return 0;  
}
```


3.5. I8024_CurrentOut_Hex / pac_i8024W_CurrentOut_Hex

This function makes the module to output the specified current value in HEX format.

Syntax

For MiniOS7

```
void I8024_CurrentOut_Hex(int slot, int ch, int hData);
```

For Windows (CE and WES)

```
void pac_i8024W_CurrentOut_Hex(int slot, int ch, int hData);
```

For Linux

```
void I8024_CurrentOut_Hex (int slot, int ch, int hData);           // for LinPAC-8000  
void i9024_CurrentOut_Hex (int slot, int ch, int hData);           // for LinPAC-9000, LX-9000
```

Parameter

slot [in]

Specific slot number (0 - 7), except range of slot is number 1 ~ 8 for LinPAC.

ch [in]

Specifies the channel number (0 ~ 5).

data [in]

Specifies the analog output value in hexadecimal format (0h ~ 7FFFh).

Return Values

None

Examples

[C++]

```
int slot, ch, data;  
I8024_CurrentOut_Hex(slot, ch, data);
```

[C#]

```
int slot ,ch, data;  
pac8024W.CurrentOut_Hex(slot, ch, data);
```

[C] (For LinPAC)

```
int main(){  
    int slot, ch, data ,ret;  
    ret=Open_Slot(slot);  
    if (ret > 0) {  
        printf("Open Slot%d failed, return value=%d \n", slot, ret);  
        return (-1);  
    }  
  
    I8024_Init(slot);  
    I8024_CurrentOut_Hex (slot, ch, data);  
    Close_Slot(slot);  
    return 0;  
}
```

Appendix A. Error Code

Error Code	Definition	Description
0	NoError	This indicates that there have been no errors
-1	ID_ERROR	There was a problem with the module ID

Appendix B. Revision History

This chapter provides revision history information to this document.

The table below shows the revision history.

Revision	Date	Description
1.0.1	January 2018	Initial issue
3.0.0	March 2018	<ul style="list-style-type: none">Added content for the I-9024 moduleModify library , demo pathAdded WP-9000 , ippc-wes7 library , demo pathModify API References
3.0.2	July 2021	<ul style="list-style-type: none">Modify Quick start.Modify the download path of libraries and demos.Added optioning modules on Linux platform.