I-8024W/I-9024 Module
User Manual

V 3.0.0 April 2018

Written by Edward Ku

Edited by Anna Huang

Warranty

All products manufactured by ICP DAS are under warranty regarding defective materials for a period of one year, beginning from the date of delivery to the original purchaser.

Warning

ICP DAS assumes no liability for any damage resulting from the use of this product. ICP DAS reserves the right to change this manual at any time without notice. The information furnished by ICP DAS is believed to be accurate and reliable. However, no responsibility is assumed by ICP DAS for its use, nor for any infringements of patents or other rights of third parties resulting from its use.

Copyright

Trademarks

Names are used for identification purposes only and may be registered trademarks of their respective companies.

Contact Us

If you have any problems, please feel free to contact us.
You can count on us for a quick response.
Email: service@icpdas.com

Table of Contents

1. Introduction

The I-8024W/I-9024 is a 14-bit source type analog output module, which offers 4 single-ended analog output channels. Every channel can be programmed to an individual output range of ±10 V or 0 ~ +20 mA.

The I-8024W/I-9024 provides 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.

1.1. Features

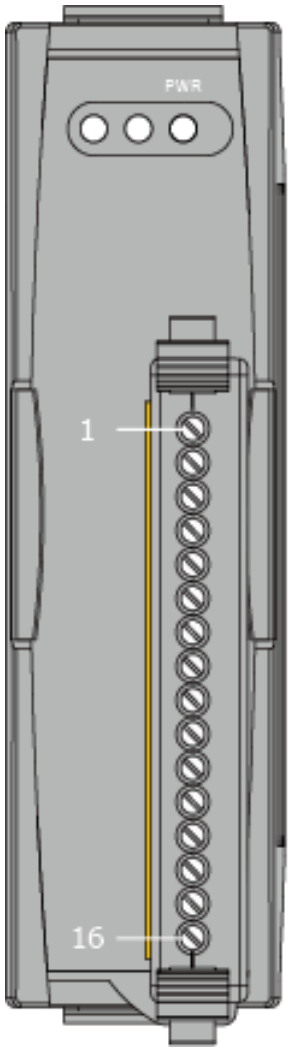
- 4-channel Voltage or Current Output
- Individual Channel Configuration
- 3000 VDC Intra-module Isolation
- Open Wire Detection for Current Output
- RF Immunity
- Short Circuit Protection
- 4 kV ESD Protection
- Wide Operating Temperature Range: -25 to +75°C

1.2. Specifications

Analog Output	
Channels	4
Range	+/- 10V, 0 ~ +20 mA
Resolution	14-bit
Accuracy	+/- 0.1% of FSR for voltage output ; +/- 0.2% of FSR for current output
ReadbackAccuracy	+/-1% of FSR
Zero Drift	Voltage: +/-30 µV/ °C Current: +/-0.2 µA/ °C
Span Drift	+/- 20ppm/°C
Voltage Output Capability	10 V @ 20 mA
Max Current Load Resistance	External +24V : 1050 Ohms
4KV ESD Protection	Yes, Contact for each terminal.
Intra-module Isolation, Field to Logic	3000 VDC
LED Indicators	
System LED Indicator	1 LED as Power/Communication Indicator
Power	
Power Consumption	0.4 A @ 5 V_{DC} = 2W ,+/- 5%
Environment	
Operating Temperature	-25 ~ +75°C
Storage Temperature	-30 ~ +75°C
Humidity	10 ~ 90%, Non-condensing

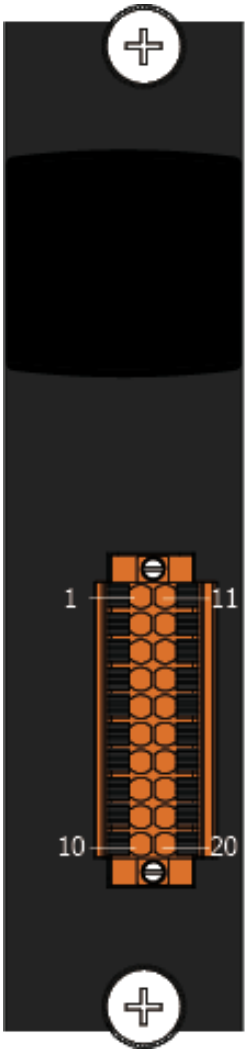
1.3. Pin Assignments

I-8024W

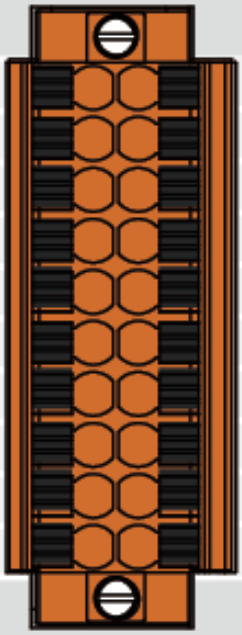


Terminal No.	Pin Assignment
01	Iout0
02	AGND
03	Iout1
04	AGND
05	Iout2
06	AGND
07	Iout3
08	AGND
09	Vout0
10	AGND
11	Vout1
12	AGND
13	Vout2
14	AGND
15	Vout3
16	AGND

I-9024



Pin Assignment	Terminal No.		Pin Assignment
VO0	01	11	I0
AGND	02	12	AGND
VO1	03	13	I1
AGND	04	14	AGND
VO2	05	15	I2
AGND	06	16	AGND
VO3	07	17	I3
AGND	08	18	AGND
-	09	19	-
FG	10	20	FG

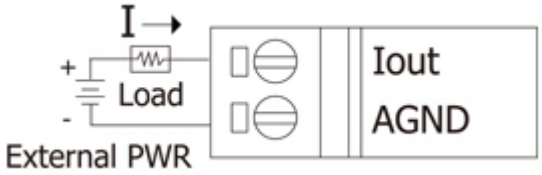


20-pin Connector

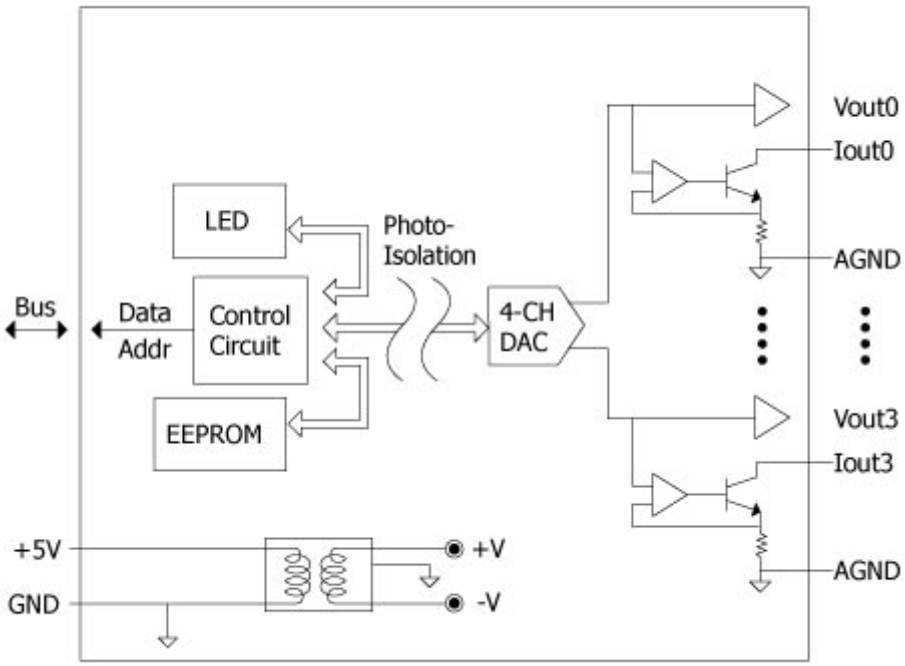
1.4. Wire Connections

Voltage Output Wiring

Current Output Wiring

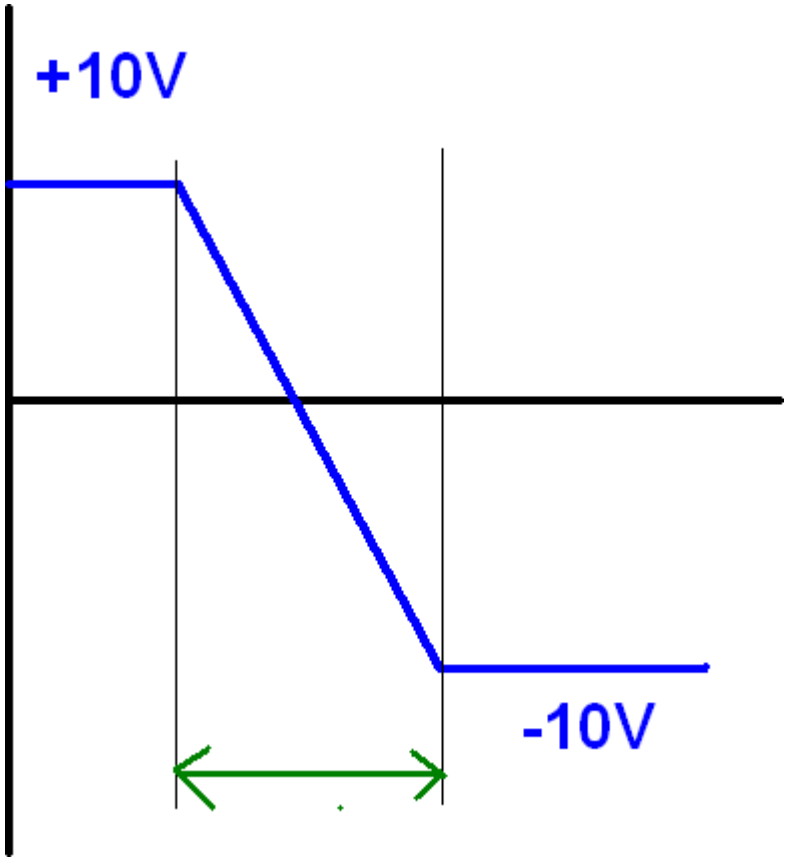


1.5. Block Diagram



1.6. Slew Rate

The Slew rate of I-8024W module is about 16 us (62.5 K Hz) from +10 V to -10V as below picture.



1.7. Demo Programs

ICP DAS provides a range of demo programs for different platforms that can be used to verify the functions of the I-8024W/I-9024. The source code contained in these programs can also be reused in your own custom programs if needed. The following is a list of the locations where both the demo programs and associated libraries can be found on either the ICP DAS web site or the enclosed CD.

Platform	Location
For I-8000	
Library	CD:\Napdos\8000\841x881x\demo\Lib or ftp://ftp.icpdas.com/pub/cd/8000cd/napdos/8000/841x881x/demo/lib/
Demo	CD:\Napdos\8000\841x881x\demo\IO_in_Slot or ftp://ftp.icpdas.com/pub/cd/8000cd/napdos/8000/841x881x/demo/io_in_slot/
For iPAC-8000	
Library	CD:\Napdos\iPAC8000\Demo\Basic\iP-84x1_iP-88x1\Lib or ftp://ftp.icpdas.com/pub/cd/8000cd/napdos/ipac8000/demo/basic/ip-84x1_ip-88x1/lib/
Demo	CD:\Napdos\iPAC8000\Demo\Basic\iP-84x1_iP-88x1\IO_in_Slot or ftp://ftp.icpdas.com/pub/cd/8000cd/napdos/ipac8000/demo/basic/ip-84x1_ip-88x1/io_in_slot/
For Windows CE5	
Library	CD:\napdos\wp-8x4x_ce50\sdk\IO_Modules or ftp://ftp.icpdas.com/pub/cd/winpac/napdos/wp-8x4x_ce50/sdk/io_modules/
Demo	eVC Demo: CD:\napdos\wp-8x4x_ce50\Demo\WinPAC\eVC\IO\Local or ftp://ftp.icpdas.com/pub/cd/winpac/napdos/wp-8x4x_ce50/demo/winpac/evc/io/local/ C# Demo: CD: \napdos\wp-8x4x_ce50\Demo\WinPAC\C#\IO\Local or

	ftp://ftp.icpdas.com/pub/cd/winpac/napdos/wp-8x4x_ce50/demo/winpac/c%23/io/local/
For WP-9000	
Library	CD:\WinPAC_AM335x\wp-9000\SDK\IO_Modules ftp://ftp.icpdas.com/pub/cd/winpac_am335x/wp-9000/sdk/io_modules/
Demo	VC2008 Demo: CD:\WinPAC_AM335x\wp-9000\demo\PAC\Vc2008\IO\Local ftp://ftp.icpdas.com/pub/cd/winpac_am335x/wp-9000/demo/pac/vc2008/io/local/ C# Demo: CD:\WinPAC_AM335x\wp-9000\demo\PAC\C#\IO\Local ftp://ftp.icpdas.com/pub/cd/winpac_am335x/wp-9000/demo/pac/c%23/io/local/
For XP-8000-CE6	
Library	CD:\SDK\Special_IO ftp://ftp.icpdas.com/pub/cd/xp-8000-ce6/sdk/special_io/
Demo	VC2005 Demo: CD:\Demo\XPAC\VC2005\IO\Local ftp://ftp.icpdas.com/pub/cd/xp-8000-ce6/demo/xpac/vc2005/io/local/ C# Demo: CD:\Demo\XPAC\C#\IO\Local ftp://ftp.icpdas.com/pub/cd/xp-8000-ce6/demo/xpac/c%23/io/local/
For XP-8000-Atom-CE6	
Library	CD:\SDK\Special_IO ftp://ftp.icpdas.com/pub/cd/xpac-atom-ce6/sdk/special_io/
Demo	VC2005 Demo: CD:\Demo\XPAC\VC2005\IO\Local ftp://ftp.icpdas.com/pub/cd/xpac-atom-ce6/demo/xpac/vc2005/io/local/ C# Demo: CD:\Demo\XPAC\C#\IO\Local ftp://ftp.icpdas.com/pub/cd/xpac-atom-ce6/demo/xpac/c%23/io/local/

For XP-8000-CE6	
Library	CD:\SDK\IO ftp://ftp.icpdas.com/pub/cd/xp-8000/sdk/io/
Demo	VC2005 Demo: CD:\Demo \XPAC \VC2005\IO\Local ftp://ftp.icpdas.com/pub/cd/xp-8000/demo/pacsdk/vc/io/local/ CD:\Demo \XPAC\C#\IO\Local ftp://ftp.icpdas.com/pub/cd/xp-8000/demo/pacsdk/csharp.net/io/local/windows_forms/
For XP-8000-Atom	
Library	CD:\SDK\IO ftp://ftp.icpdas.com/pub/cd/xpac-atom/sdk/io/
Demo	VC Demo: CD:\Demo \pacsdk \vc\IO\Local ftp://ftp.icpdas.com/pub/cd/xpac-atom/demo/pacsdk/vc/io/local/ C# Demo: CD:\Demo \pacsdk\csharp.net\IO\Local\windows_forms ftp://ftp.icpdas.com/pub/cd/xpac-atom/demo/pacsdk/csharp.net/io/local/windows_forms/
For ippc-WES7	
Library	CD:\ippc-wes7\sdk\IO ftp://ftp.icpdas.com/pub/cd/ippc-wes7/sdk/io/
Demo io-8k	VC Demo: CD:\ippc-wes7\demo\pacsdk\vc\io\local\io-8k ftp://ftp.icpdas.com/pub/cd/ippc-wes7/demo/pacsdk/vc/io/local/io-8k/ C# Demo: CD:\ippc-wes7\demo\pacsdk\csharp.net\io\local\io-8k ftp://ftp.icpdas.com/pub/cd/ippc-wes7/demo/pacsdk/csharp.net/io/local/io-8k/
Demo io-9k	VC Demo: CD:\ippc-wes7\demo\pacsdk\vc\io\local\io-9k ftp://ftp.icpdas.com/pub/cd/ippc-wes7/demo/pacsdk/vc/io/local/io-9k/

	C# Demo: CD:\ippc-wes7\demo\pacsdk\csharp.net\io\local\io-9k ftp://ftp.icpdas.com/pub/cd/ippc-wes7/demo/pacsdk/csharp.net/io/local/io-9k/

2. API for Windows-Based Controllers

The following table lists the functions provided in pac_8024HW.lib for Windows platform.

Function	Description
pac_i8024W_GetLibVersion	Used to read the version and build information for the currently installed Library
pac_i8024W_GetLibDate	Used to read the build date information for the currently installed Library
pac_i8024W_GetFirmwareVersion	Used to read the firmware (FPGA) version information
pac_i8024W_Initial	Used to initialize the module
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.
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.
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.
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.

2.1. pac_i8024W_GetLibVersion

This function is used to read the version and build information for the Library currently installed on the I-8024W/I-9024 module inserted in a specific slot.

Syntax

For Windows (CE and WES)

```
short pac_i8024W_GetLibVersion(void);
```

Parameters

None

Return Values

The version number and build information for the Library used by the module I-8024W/I-9024.

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

Examples

[C++]

```
short version = pac_i8024W_GetLibVersion();
```

[C#]]

```
Int16 version = pac8024W.LibVersion();
```

2.2. pac_i8024W_GetLibDate

This function is used to read the build date information for the Library currently installed on the I-8024W/I-9024 module inserted in a specific slot

Syntax

For Windows (CE and WES)

```
void pac_i8024W_GetLibDate(char libDate[]);
```

Parameters

libDate [out]

A string indicating the build date of the Library used by the module with a null terminal.

Return Values

None

Examples

[C++]

```
char* builtDate;
pac_i8024W_GetLibDate(builtDate);
```

[C#]

```
string builtDate;
builtDate = pac8024W.GetLibDate();
```

2.3. pac_i8024W_ GetFirmwareVersion

This function is used to read the firmware (FPGA) version information for the I-8024W/I-9024 module inserted in a specific slot.

Syntax

For Windows (CE and WES)

```
short pac_i8024W_GetFirmwareVersion(
    int slot,
);
```

Parameters

slot [in]

Specifies the slot where the I-8024W/I-9024 is plugged in (Range: 0 to 7).

Return Values

The version number and build information for the Firmware used by the module I-8024W/I-9024. Refer to Appendix A: “Error Code Definitions” for more details.

Examples

[C++]

```
int slot;
short firmware = pac_i8024W_GetFirmwareVersion(slot);
```

2.4. pac_i8024W_ Initial

This function is used to initialize the I-8024W/I-9024 module inserted in a specified slot, and must be called at least once before using any other function.

Syntax

For Windows (CE and WES)

```
short pac_i8024W_Init(int slot);
```

Parameters

slot [in]

Specifies the slot where the I-8024W/I-9024 is plugged in (Range: 0 to 7).

Return Values

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

Examples

[C++]

```
int slot;
short ret = pac_i8024W_Init(slot);
```

[C#]

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

2.5. pac_i8024W_ VoltageOut

This function makesI-8024W/I-9024 modules to output the voltage of specified floating-point value in the specified channel and slot.

Syntax

For Windows (CE and WES)

```
void pac_i8024W_ VoltageOut (
    int slot,
    int ch,
    float data
);
```

Parameter

slot [in]

Specifies the slot where the I-8024W/I-9024 is plugged in (Range: 0 to 7).

ch [in]

Specifies the channel from which I/8024W/I-9024 outputs (Range: 0 to 3).

data [in]

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

Return Values

None

Examples

[C++]

```
int slot , ch ;
float data ;
pac_i8024W_ VoltageOut(slot, ch, data);
```

[C#]

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

2.6. 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.

Syntax

For Windows (CE and WES)

```
void pac_i8024W_ CurrentOut(
    int slot,
    int ch,
    float data
);
```

Parameter

slot [in]

Specifies the slot where the I-8024W/I-9024 is plugged in (Range: 0 to 7).

ch [in]

Specifies the channel from whichI-8024W/I-9024 outputs (Range: 0 to 3).

data [in]

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

Return Values

None

Examples

[C++]

```
int slot , ch ;
float data;
pac_i8024W_ CurrentOut(slot, ch, data);
```

[C#]

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

2.7. pac_i8024W_ VoltageOut_Hex

This function makesI-8024W/I-9024 modules to output the specified voltage value in HEX format in the specified channel and slot.

Syntax

For Windows (CE and WES)

```
void pac_i8024W_ VoltageOut_Hex(
    int slot,
    int ch,
    int data
);
```

Parameter

slot [in]

Specifies the slot where the I-8024W/I-9024 is plugged in (Range: 0 to 7).

ch [in]

Specifies the channel from which I-8024W/I-9024 outputs (Range: 0 to 3).

data [in]

Specifies analog output data with hexadecimal value(Voltage range: 8000h ~ 7FFFh, that is -32768 ~ +32767, linearly maps to the range of voltage output: -10 ~ +10 V).

Return Values

None

Examples

[C++]

```
int slot, ch, data;
pac_i8024W_ VoltageOut_Hex(slot, ch, data);
```

[C#]

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

2.8. 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.

Syntax

For Windows (CE and WES)

```
void pac_i8024W_ CurrentOut_Hex(
    int slot,
    intch,
    int data
);
```

Parameter

slot [in]

Specifies the slot where the I-8024W/I-9024 is plugged in (Range: 0 to 7).

ch [in]

Specifies the channel from which I-8024W/I-9024 outputs (Range: 0 to 3).

data [in]

Specifies analog output data with hexadecimal value (Current range: 0h ~ 7FFFh, that is 0 ~ +32767, linearly maps to the range of current output: 0. ~ +20.mA).

Return Values

None

Examples

[C++]

```
int slot, ch, data;
pac_i8024W_ CurrentOut_Hex(slot, ch, data);
```

[C#]

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

3. API for MiniOS7-based Controller

The following is a list of the functions provided in the 8024W.lib for theMiniOS7 platform.

Function	Description
i8024W_Initial	This function initializes the module I-8024W/I-9024 in the specified slot. You must implement this function once before you try to use the otherI-8024W/I-9024 functions.
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.
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.
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.
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. i8024W_Initial

This function initializes the module I-8024W/I-9024 in the specified slot. You must implement this function once before you try to use the other I-8024W/I-9024 functions.

Syntax

For MiniOS7 (i-8000/iP-8000)

```
short i8024W_Initial(
   int slot
);
```

Parameter

slot [in]

Specifies the slot in which the I-8024W/I-9024 plugged (Range: 0 to 7).

Return Values

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

Examples

[C++]

```
int slot;
i8024W _Initial (slot);
```

3.2. i8024W_VoltageOut

This function makesI-8024W/I-9024 modules to output the voltage of specified floating-point value in the specified channel and slot.

Syntax

For MiniOS7 (i-8000/iP-8000)

```
void i8024W_VoltageOut(
    int slot,
    int ch,
    float data
);
```

Parameter

slot [in]

Specifies the slot in which the I-8024W/I-9024 plugged (Range: 0 to 7).

ch [in]

Specifies the channel from which I/8024W/I-9024 outputs (Range: 0 to 3).

data [in]

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

Return Values

None

Examples

[C++]

```
int slot, ch;
float data;
i8024W_VoltageOut (slot, ch, data);
```

3.3. 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.

Syntax

For MiniOS7 (i-8000/iP-8000)

```
void i8024W_CurrentOut(
    int slot,
    int ch,
    float data
);
```

Parameter

slot [in]

Specifies the slot in which the I-8024W/I-9024 plugged (Range: 0 to 7).

ch [in]

Specifies the channel from whichI-8024W/I-9024 outputs (Range: 0 to 3).

data [in]

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

Return Values

None

Examples

[C++]

```
int slot , ch;
float data;
i8024W_CurrentOut (slot, ch, data);
```

3.4. i8024W_VoltageOut_Hex

This function makesI-8024W/I-9024 modules to output the specified voltage value in HEX format in the specified channel and slot.

Syntax

For MiniOS7 (i-8000/iP-8000)

```
void i8024W_VoltageOut_Hex(
    int slot,
    int ch,
    int data
);
```

Parameter

slot [in]

Specifies the slot in which the I-8024W/I-9024 plugged (Range: 0 to 7).

ch [in]

Specifies the channel from which I-8024W/I-9024 outputs (Range: 0 to 3).

data [in]

Specifies analog output data with hexadecimal value(Voltage range: 8000h ~ 7FFFh, that is -32768 ~ +32767, linearly maps to the range of voltage output: -10 ~ +10 V).

Return Values

None

Examples

[C++]

```
int slot, ch, data ;
i8024W_VoltageOut_Hex (slot, ch, data);
```

3.5. 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.

Syntax

For MiniOS7 (i-8000/iP-8000)

```
void i8024W_CurrentOut_Hex(
    int slot,
    int ch,
    int data
);
```

Parameter

slot [in]

Specifies the slot in which the I-8024W/I-9024 plugged (Range: 0 to 7).

ch [in]

Specifies the channel from which I-8024W/I-9024 outputs (Range: 0 to 3).

data [in]

Specifies analog output data with hexadecimal value (Current range: 0h ~ 7FFFh, that is 0 ~ +32767, linearly maps to the range of current output: 0. ~ +20.mA).

Return Values

None

Examples

[C++]

```
int slot, ch ,data;
i8024W_CurrentOut_Hex (slot, ch, data);
```

Appendix A. Error Code

Error Code	Definition	Description
0	NoError	No error occurred
-1	ID_ERROR	There was a problem with the module ID
-2	SLOT_ERROR	There was a Slot index error (0 - 7)
-3	CHANNEL_ERROR	There was a Channel index error (0 - 15)
-4	GAIN_ERROR	There was a Gain error (0 - 4)
-5	INT_MODE_ERROR	
-6	NOT_SUPPORT_ERROR	
-7	INVALID_Calibration	
-8	Bad_Calibration	

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	April 2018	• Modify library , demo path • Added WP-9000 , ippc-wes7 library , demo path • Added 2.API for Windows-Based Controllers • Modify 3. API for MiniOS7-based Controller