

i³ Analogue I/O Tutorial

Introduction

The purpose of this tutorial is to demonstrate the Analogue input / output capabilities of the i³. This tutorial will also display how to use the scaling function.

The i³ integrated controller can, depending on the model chosen have up to 4 analogue inputs as with model 10D03 or, in the case of model 13C14, have 2 analogue inputs and 2 analogue outputs.

The resolution of the individual I/O points is also dependant on the model selected. This ranges from 2 bit to 14 bit resolution for inputs and 12 bit resolution output for the outputs. The analogue value is represented by an integer value 0 - 32,767. An important point to remember is that the %AQ registers have other uses, i.e. they are used in setting up the PWM output and therefore the two physical outputs on the model 13C14 are addressed at %AQ09 and %AQ10.

Hardware Setting

Analogue I/O Type Selection

The i³ can have both voltage (0-10Vdc) and current (0-20mA and 4-20mA) input and output. The 13C14 models also supports PT100, Thermocouples of types J, K, N, T, E, R, S, B, and 100mV signals. To select the desired input, there are some hardware setting and software setting. Jumper pins need to be set that are located inside the casing, to access these jumpers, the back section of the case needs to be removed as shown in Figure 1.

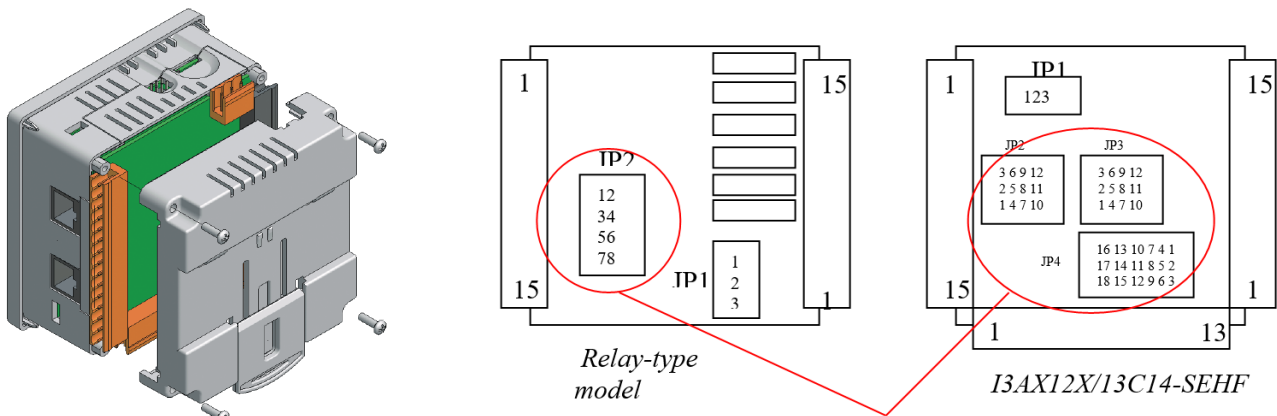


Figure 1: Removing the Back Cover

Jumpers are needed to be set as follows, i³BX models are identical.

Function JP2	i3AX12X/13C14-SEHF 20mA	i3AX12X/10D03-SEHF 20mA	i3AX12X/10B04-SEHF 20mA	i3AX12X/20B05-SEHF 20mA	All 10V
Channel 1	1-2	1-2	1-2	1-2	Open
Channel 2		3-4	3-4	3-4	Open
Channel 3		5-6			Open
Channel 4		7-8			Open

Note: i3AX12X/10E24-SEHF does not need any jumper settings. All configuration can be completed via software.

i3AX12X/13C14-SEHF & i3BX12Y/13C14-SEHF:

Link No.	Function	20mA	10V	PT100	Thermocouple
JP2	AI 1	8-9	8-9	2-3	1-2
		11-12	11-12	5-6	4-5
				7-8	7-8
				10-11	10-11
JP3	AI 2	8-9	8-9	2-3	1-2
		11-12	11-12	5-6	4-5
				7-8	7-8
				10-11	10-11
JP4	OUTPUT 1	1-2	2-3		
		4-5	5-6		
		7-8	8-9		
	OUTPUT 2	10-11	11-12		
		13-14	14-15		
		16-17	17-18		

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Software Configuration

In the software (i³ configurator) the analogue I/O also needs to be set.

The diagram illustrates the software configuration steps for analogue I/O in the i³ configurator. It shows the 'Hardware Configuration' window and the 'Module Configuration' window, with annotations guiding the user through the process.

Hardware Configuration Window:

- Controller: Local I/O
- CAN1 (CAN) I/O
- i3AX12X/xxxxx - iCAN
- i3AX12X/20B05-SCHF
- Empty
- Config buttons for each module
- OK, Cancel, Apply buttons at the bottom

Module Configuration Window:

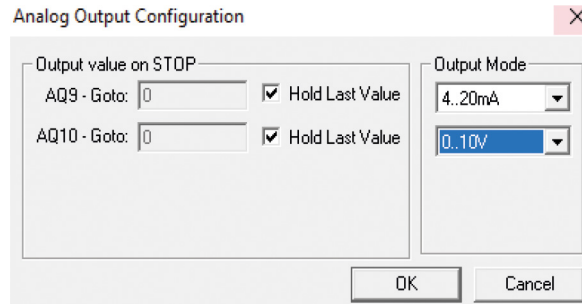
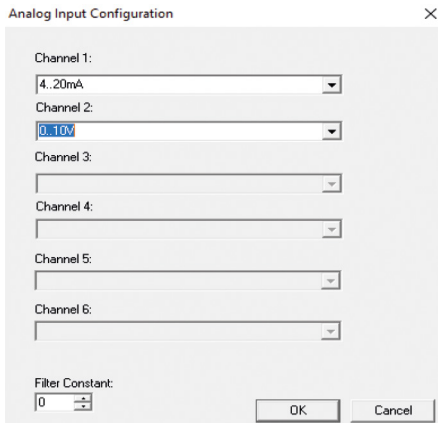
- I/O Map | Module Setup
- Module: 20B05
- Description: 24DC in, 16DC out, 2 10-bit AI, 4 HSC, 2 PWM
- Table of I/O modules:

Type	Starting Register	Ending Register	Number of Registers
%I	1	32	32
%Q	1	24	24
%AI	1	12	12
%AQ	1	8	8

Annotations:

- Click here to configure the i³ Model type (points to the Hardware Configuration window)
- Click here to modify the I/O (points to the Config button in the Hardware Configuration window)
- Click on the module set up (points to the Module Configuration window)
- Click on the box to edit the details (points to the Digital In / HSC box in the Module Configuration window)
- There is no Analogue output on this model (points to the Analog Out box in the Module Configuration window)
- Click OK to confirm selection (points to the OK button in the Module Configuration window)

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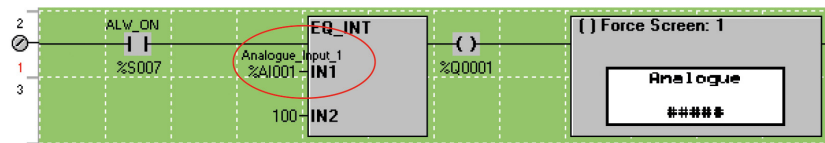


On this model we can select the type of input for two channels. The channels are independent and can be voltage or current

Programming the Analogue I/O

Once the analogue inputs have been set to match the external inputs to the controller we can call the analogue inputs using the addressing structure.

%AI1 – Analogue input 1 } and so on
%AQ9 – Analogue output 1



Configuring the I/O

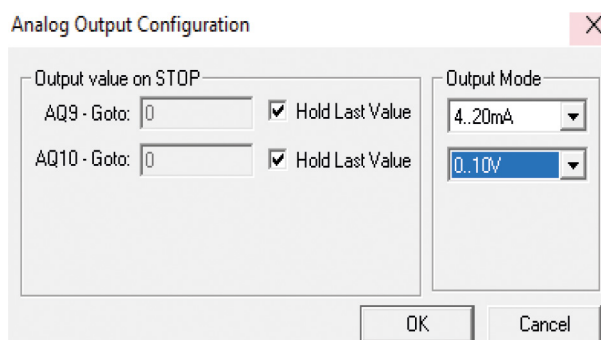
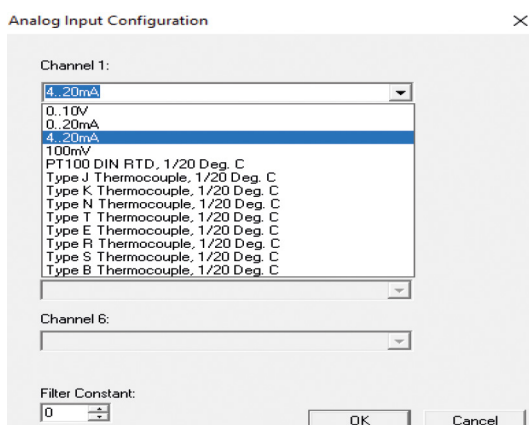
For example we can use an i³ to read in an analogue speed reference and output an analogue speed reference to an inverter drive.

The input and output will be scaled to 0-100%. The user will be able to input a speed reference (0-100%) to output to the drive.

Using the i3AX12X/13C14-SEHF, this unit has 2x14 bit analogue inputs and 2x12 bit analogue outputs. The input will be set to 4-20mA and the output will be set to 0-10V. Note the output addresses are %AQ9 and %AQ10.

First steps prior to programming

- Set the Hardware jumper pins to the correct position.
 - Jumper JP2 Link 8-9 (20mA) AI1.
 - Jumper JP4 Link 2-3 (10V) AQ9.
 - Power up the i³.
- Open i³ Configurator and Configure the I/O
 - Controller Menu and select Config I/O
 - Auto Config System
 - Configure the Analogue I/O

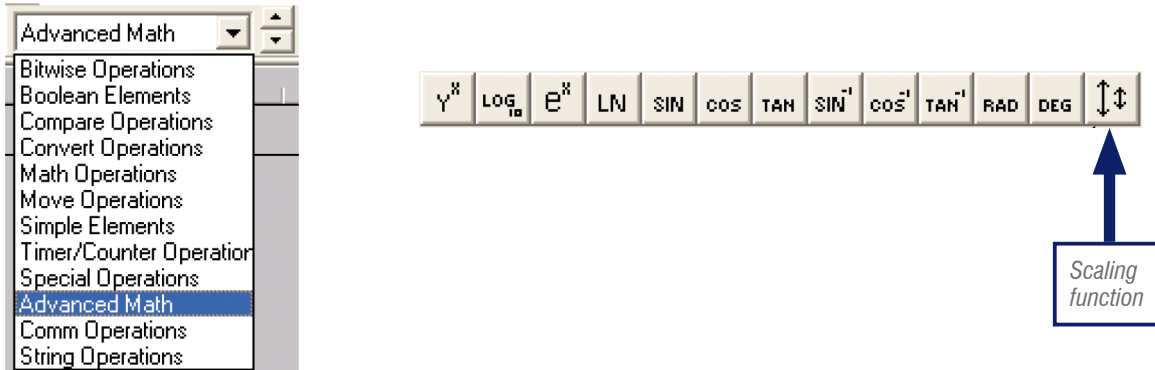


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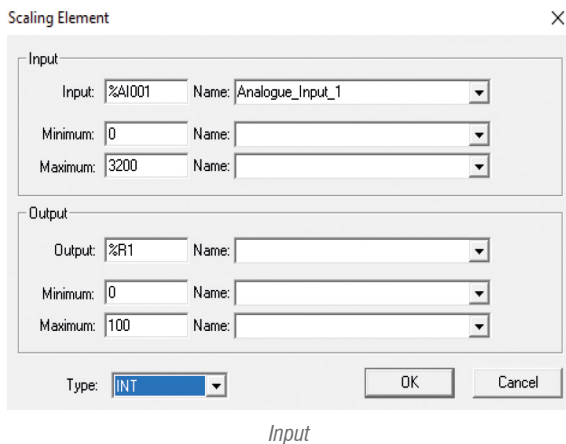
Ladder Logic Programming

Select a N/O contact and insert it at Rung 1. Assign the contact to the internal bit %S7, Always ON (ALW_ON).

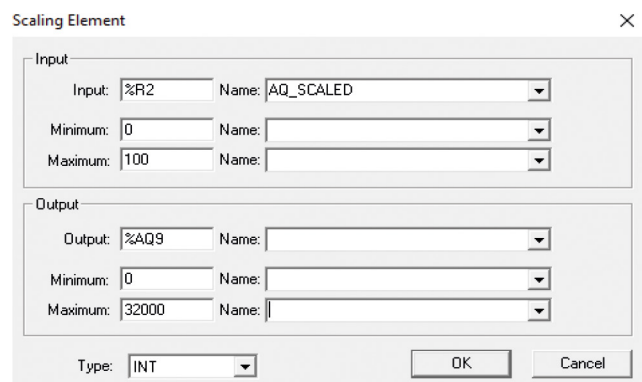
Now select the scale function from the Advanced Maths Functions and insert it in the same rung as the %S7 N/O Always On (ALW_ON) contact.



The analogue value ranges from 0 to 32767 and we want to scale the input to 0 to 100. Similarly with the output, we want to do the opposite.



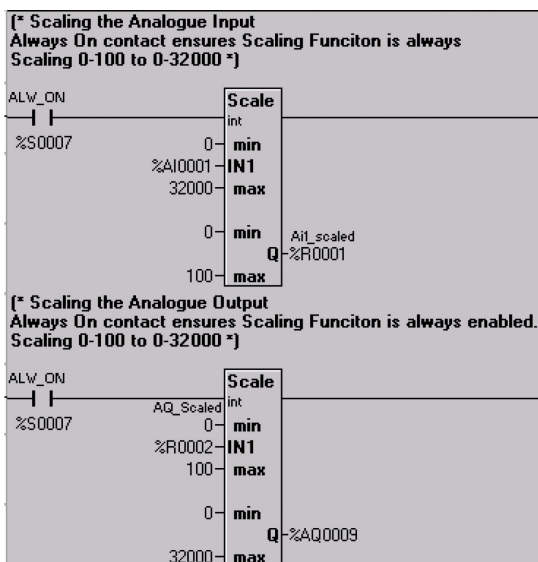
Input



Output

The analogue outputs register is also used for setting the PWM and the physical analogue outputs begin at %AQ09. Therefore for the model i3AX12/13C14-SEHF the analogue outputs will be %AQ9 and %AQ10.

The ladder logic should now appear as shown below. To insert comments, right click in the margin of the Rung and select 'New Comment'. Or, click on the comment Bubble icon on the toolbar and click to place.



If we now Error Check () the ladder program; we will find there are no errors. Now we are required to configure an initial screen.

Click the Screen Editor icon ()

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Screen Editor Configuration

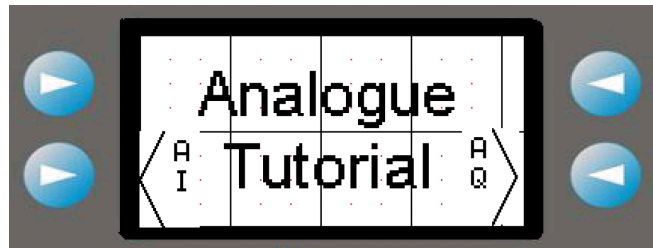
We are going to configure three screens:

1. Main menu
2. Input Speed, with actual input and scaled input
3. Output Speed, with a bar graph.

On the main menu we are going to enter 2 Screen Jump buttons, to jump to the input and output screens and a Static Text to display the title "Analogue Tutorial"

Screen Properties:

Screen Jump 1	Screen Jump 2	Static Text
Address = 2	Address = 2	Font = San Serif 15
Attributes: No border or icon	Attributes: No border or icon	Text = "Analogue Tutorial"
Legend = AI	Legend = AQ	Text = Centred

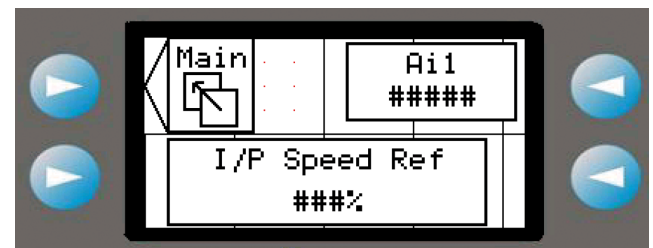


Screen 1

On the Analogue Input screen we are going to display the actual analogue value in %AI01, the scaled analogue value and a button to jump back to the main menu.

Screen Properties:

Numeric Data 1	Numeric Data 2	Screen Jump
Address = %R01	Address = %AI01	Address = 1
Data centred, non-editable, 3 digits. % as engineering units	Data centred, non-editable, 5 digits	Attributes: Border and icon checked
Legend = "I/P Speed Ref"	Legend = "AI1"	Legend = "Main"

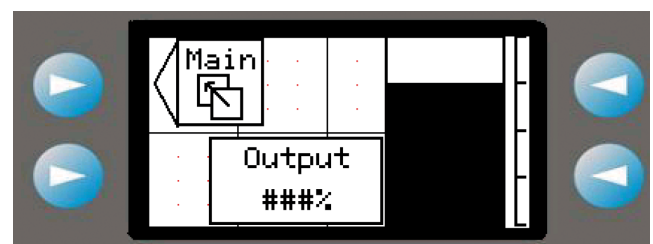


Screen 2

On the analogue output screen there is going to be a Jump Screen function to go back to the main menu, a numeric field to enter an output percentage for the speed reference and a bar graph to illustrate the percentage output.

Screen Properties:

Numeric Data	Bar Graph	Screen Jump
Address = %R02	Address = %R02	Address = 1
Data centred, editable, 3 digits. % as engineering units. Min = 0, Max = 100	Scale not displayed. Max = 100, Min = 0	Attributes: Border and icon checked
Legend = "Output"	Legend = ""	Legend = "Main"

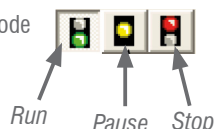


Screen 3

A final Error Check, before exiting the screen editor. With no errors we can now download the program.



After downloading the program, ensure you put the i³ into RUN mode



www.imopc.com

IMO Precision Controls Ltd

Unit 3, The Interchange, Frobisher Way
Hatfield, Hertfordshire AL10 9TG UK

Tel: +44 (0)1707 414 444
Fax: +44 (0)1707 414 445

Email: sales@imopc.com
Web: www.imopc.com



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