

User Manual

iR-AQ04-VI iR-AM06-VI iR-AI04-VI User Manual

This guide walks through important information about iR-Axxx-VI Series.

UM018013E_20231106

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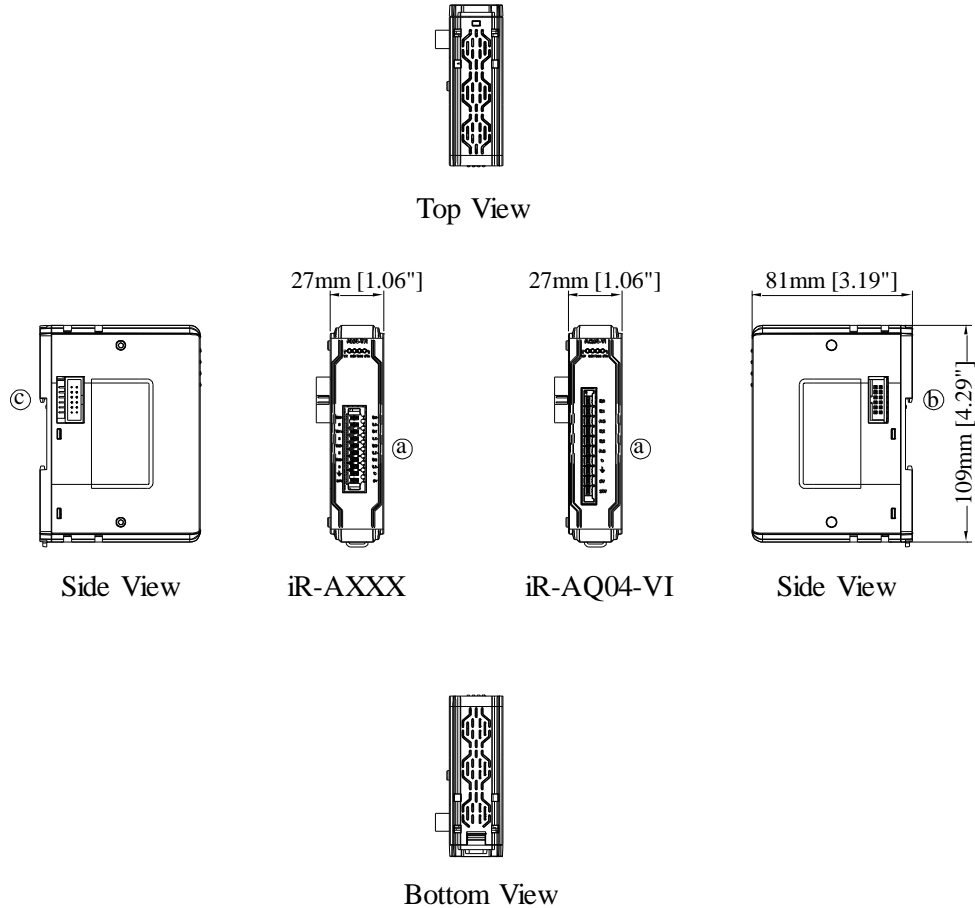
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1. Product Overview



<i>a</i>	Terminal	<i>b.c</i>	Expansion Connector
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2. Specifications

2.1 Modules Specification

Module Name		iR-AI04-VI	iR-AM06-VI	iR-AQ04-VI
Number of Analog Inputs		4	4	0
Number of Analog outputs		0	2	4
Current Consumption		70mA@5VDC	70mA@5VDC	65mA@5VDC
Analog Power Supply		24 VDC (20.4 VDC~28.8 VDC) (-15%~+20%)		
Specification	PCB Coating	Yes		
	Enclosure	Plastic		
	Dimensions WxHxD	27 x 109 x 81 mm		
	Weight	Approx. 0.12 kg		
	Mount	35mm DIN rail mounting		
Environment	Protection Structure	IP20		
	Storage Temperature	-20° ~ 70°C (-4° ~ 158°F)		
	Operating Temperature	0° ~ 55°C (32° ~ 131°F)		
	Relative Humidity	10% ~ 90% (non-condensing)		
	Vibration Resistance	Conforms to EN 60068-2-6 / EN 60068-2-27		
Connection	Cross-section	AWG 28-16		AWG 24-16
Certification	EMC Immunity	Conforms to EN 55032: 2012+AC: 2013, Class A EN 61000-6-4: 2007+A1:2011 EN 55024: 2010+A1: 2015 EN 61000-6-2:2005		

2.2 Analog Input Specification

Input Range	-10V~10V 、 -20mA~20mA				
Conversion Time	2ms/Channel				
Isolation	500 VDC : (Analog / Digital)				
Data Format	-10~10V	-5~5V	1~5V	-20~20mA	4~20mA
	±32000	±32000	0~32000	±32000	0~32000
Resolution	0.312mV	0.156mV	0.156mV	0.625uA	0.625uA
	16 bit	16 bit	15 bit	16 bit	15 bit
Input Impedance	1MΩ			250 Ω	
Maximum Voltage / Current Range	-15~15V			-25~25mA	
Overflow Range	-10.12~10.12V			-20.24~20.24mA	
Diagnose	Supply Voltage Wire break (1~5V & 4~20mA) Overflow/underflow				
Accuracy	± 0.2 % Full Scale@25°C ± 0.3 % Full Scale@0° ~ 55°C				

2.3 Analog Output Specification

Output Range	-10V~10V 、 -20mA~20mA				
Conversion Time	1.6ms/4 channels				
	1.3ms/3 channels				
	1ms/2 channels				
	700us/1 channel				
Isolation	500 VDC : (Analog / Digital)				
Data Format	-10~10V	-5V~5V	1~5V	-20~20mA	4~20mA
	±32000	±32000	0~32000	±32000	0~32000
Resolution	5mV	5mV	5mV	10uA	10uA
	12bit	11bit	10bit	12bit	11bit
Output Impedance	≥ 1kΩ			≤ 500Ω	
Diagnose	Supply Voltage				
Accuracy	± 0.2 % Full Scale@25°C ± 0.3 % Full Scale@0° ~ 55°C				

3. LED Indicators

3.1 L.V LED

State	Description
OFF	24V power normal
Blinking	Detect 24V power
ON	24V power error

3.2 RUN LED

State	Description
OFF	No Power
Blinking	iBus initiating
ON	iBus working

3.3 ERR LED

State	Description
OFF	No error
Blinking	Analog channel error
ON	Unable to perform conversion (Analog hardware error)

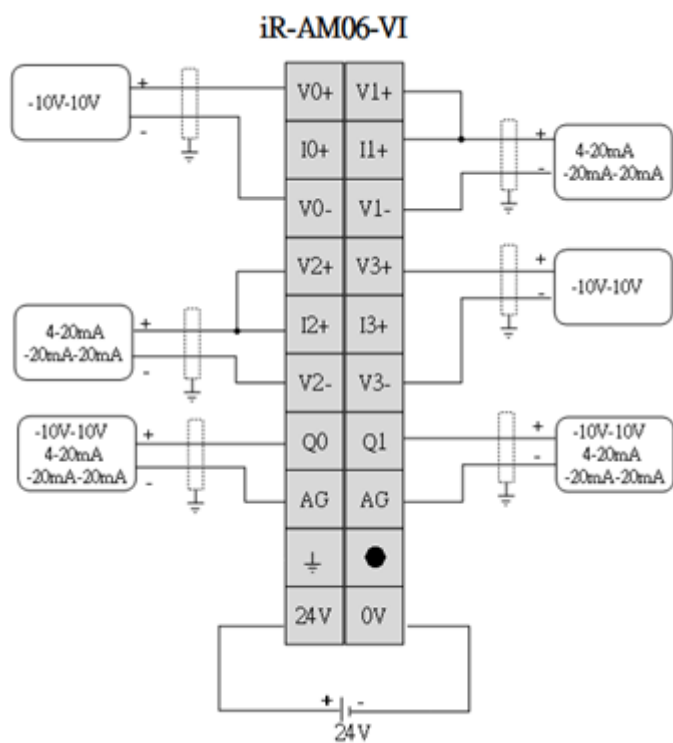
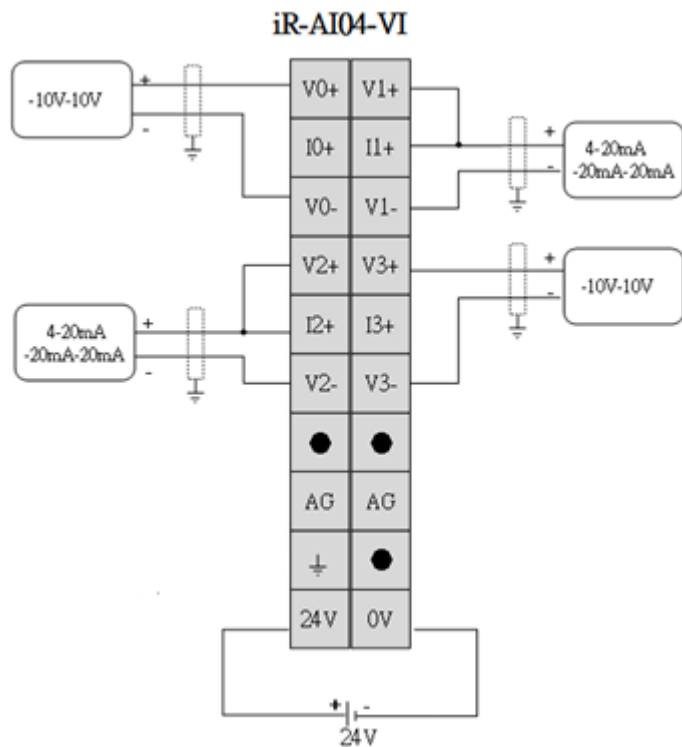
3.4 STA LED

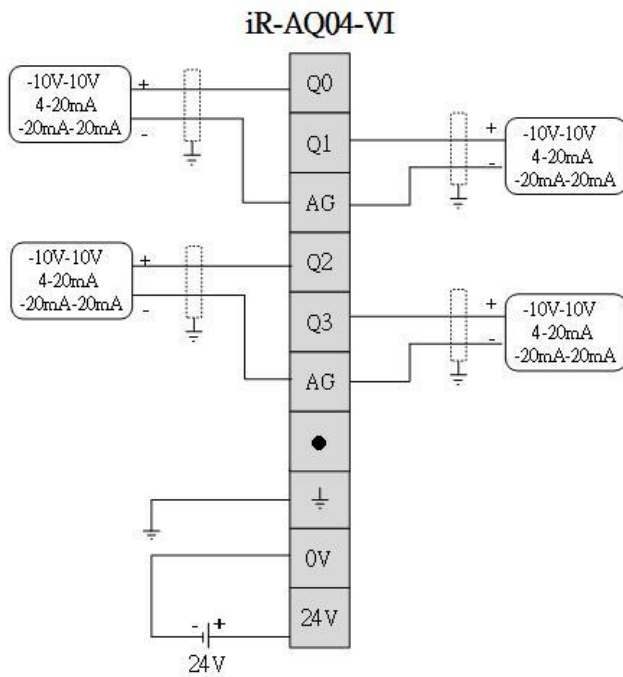
State	Description
OFF	No error
Blinking	Conversion in progress

4. Error Handling

State	Description	Error Handling
L.V LED ON	Analog power (24v) error	Check Analog power (24v)
L.V LED Blinking	Detect Analog power (24v)	Check Analog power (24v)
Run LED is OFF	No Power	Check whether the coupler is properly powered, or if module malfunction occurs. And send the malfunction unit for repair.
ERR LED ON	Unable to perform conversion	Hardware error, send the unit for repair.
RUN LED Blinking	iBus initiating	Check whether the coupler is functioning, if not, sent the unit for repair.
ERR LED Blinking	Channel conversion error	Check the error code to find out whether the Analog value exceeds allowable range.

5. Wiring

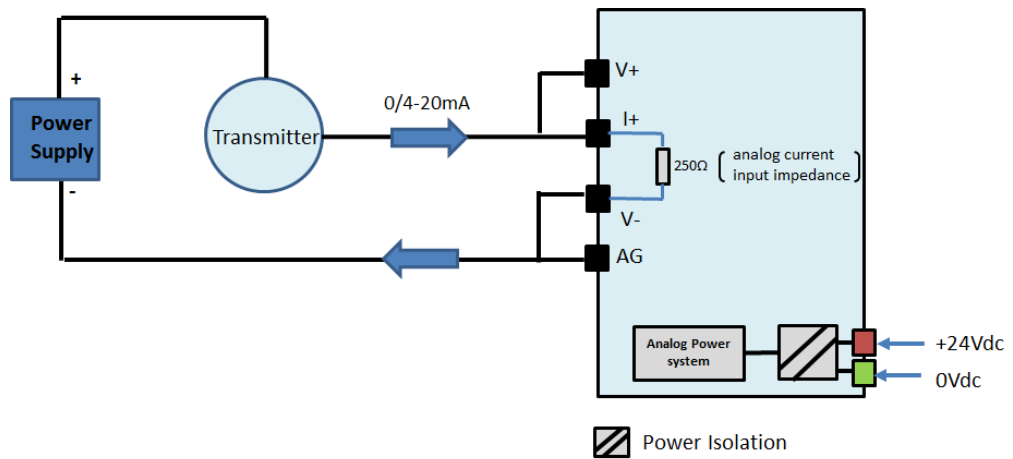




2-, 3- and 4-wire Analog Sensor connection at inputs:

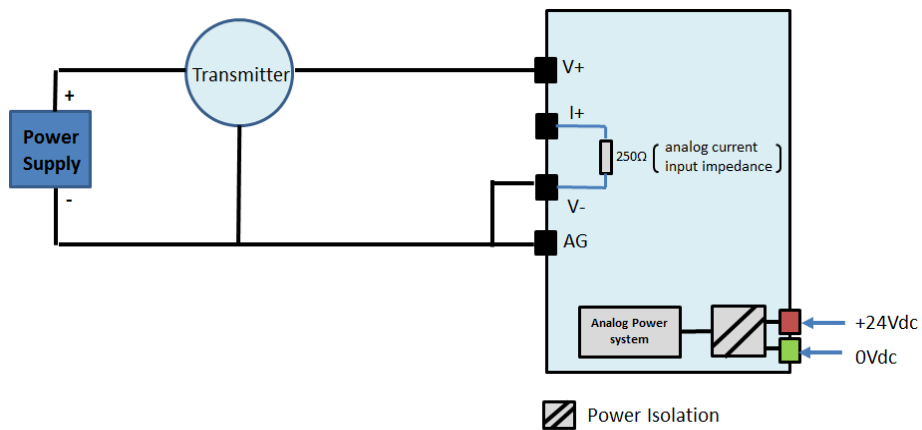
2 wire :

Current transmitter

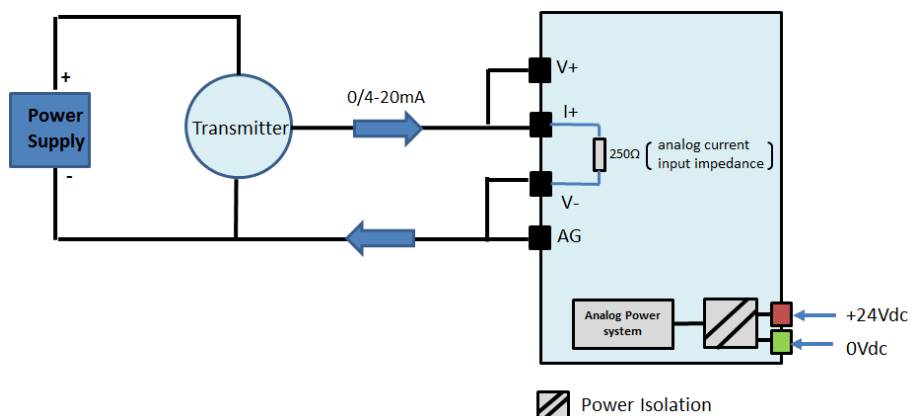


3 wire :

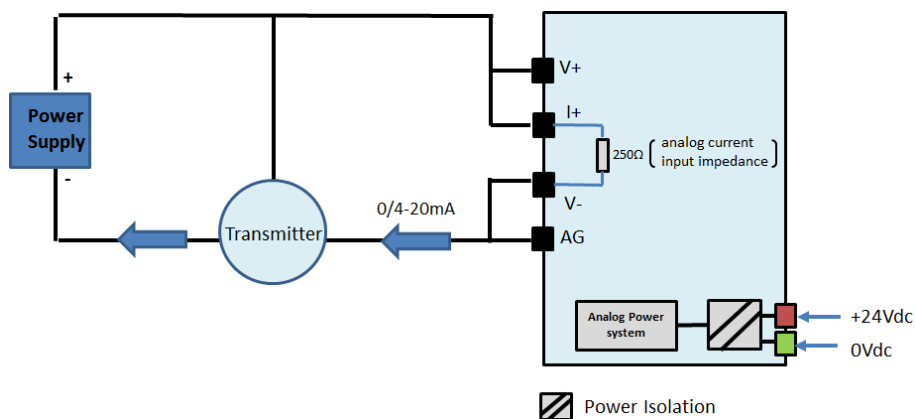
Voltage transmitter



Current Source transmitter

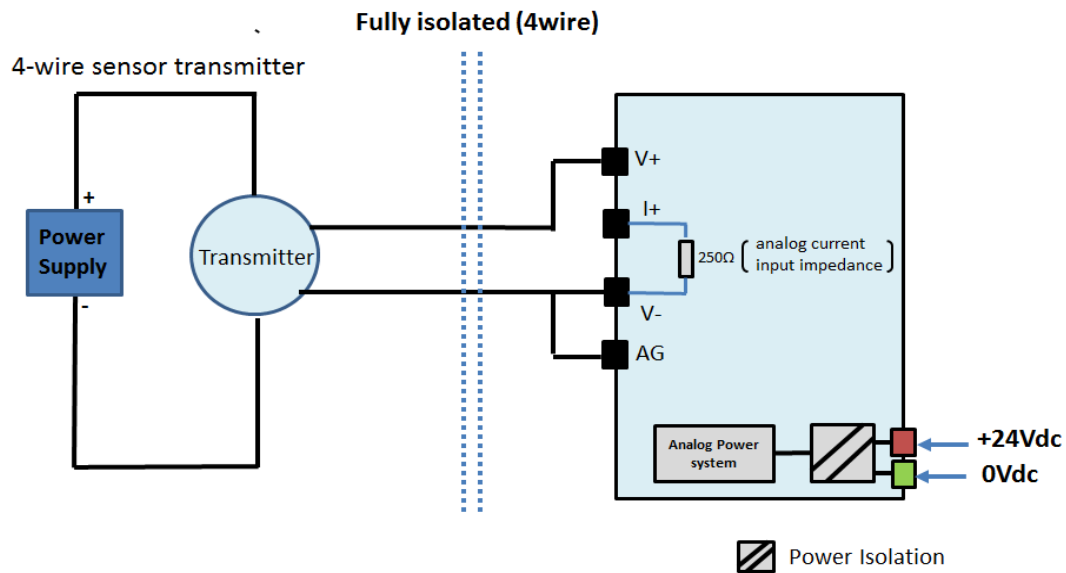


Current Sink transmitter

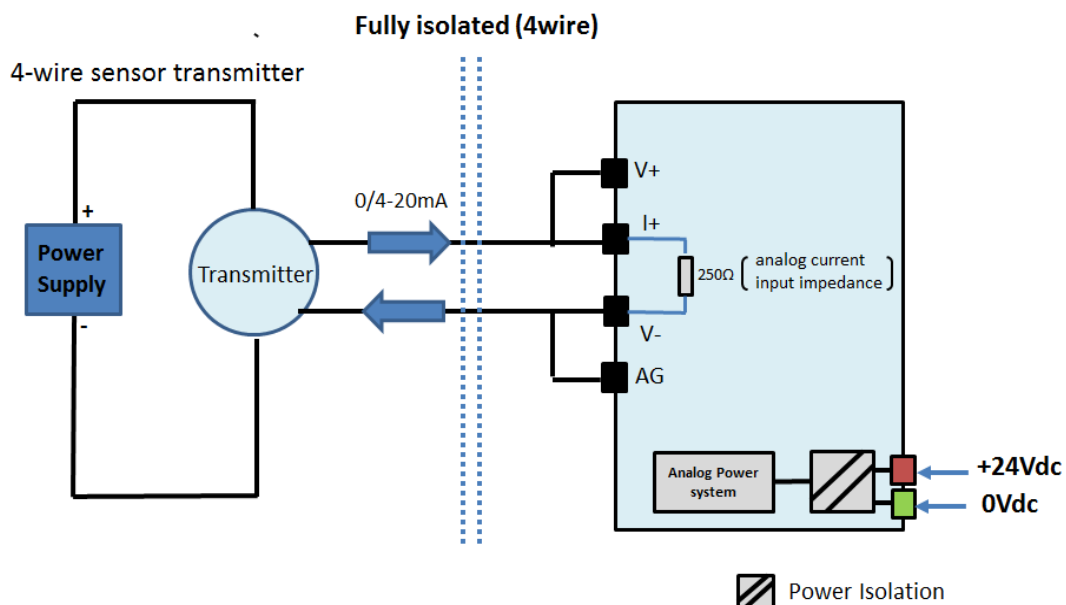


4 wire :

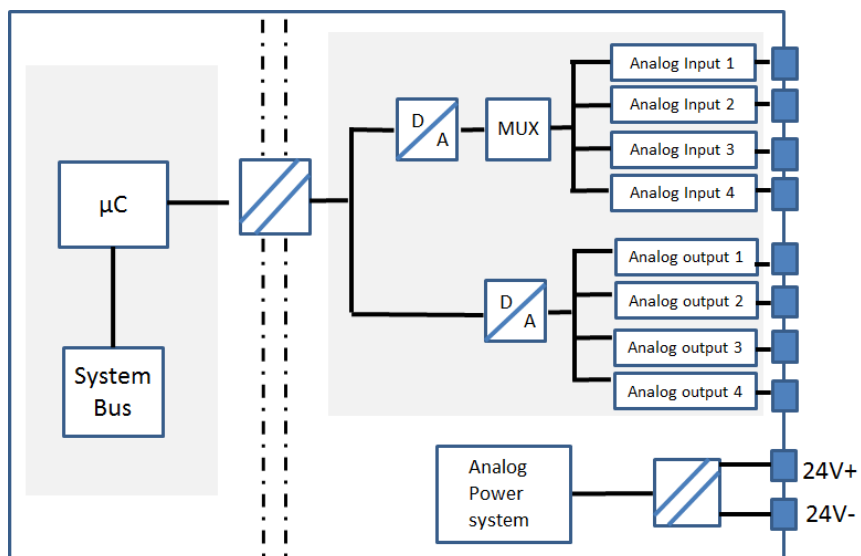
Voltage transmitter



Current transmitter



5.1 iR Analog Module Block Diagram



6. Analog I/O Features

6.1 Feature List

No.	Feature	Descriptions
1	User-Defined Conversion Rate	
2	Analog Output – Soft Start	
4	Analog Input – Diagnose	Disconnection Detection (1-5v / 4-20mA)
5	Analog Input – Fast Conversion Mode	
6	Analog Input – Digital Filter	

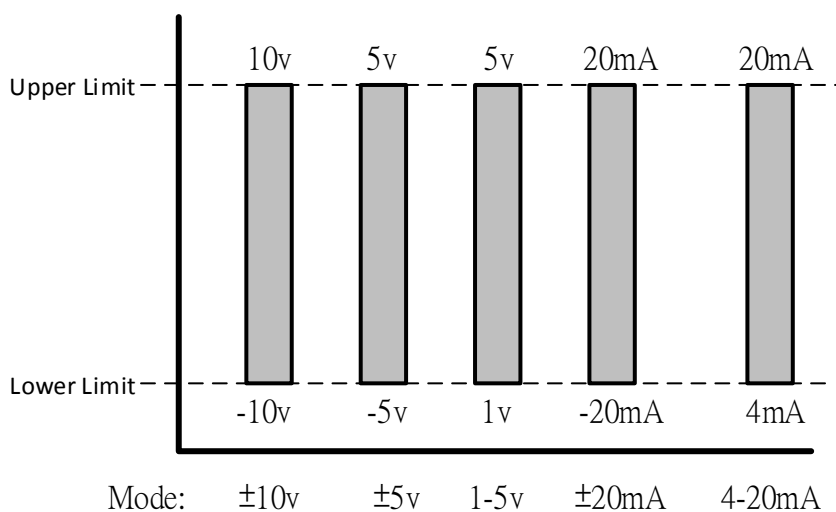
6.2 User-Defined Conversion Rate

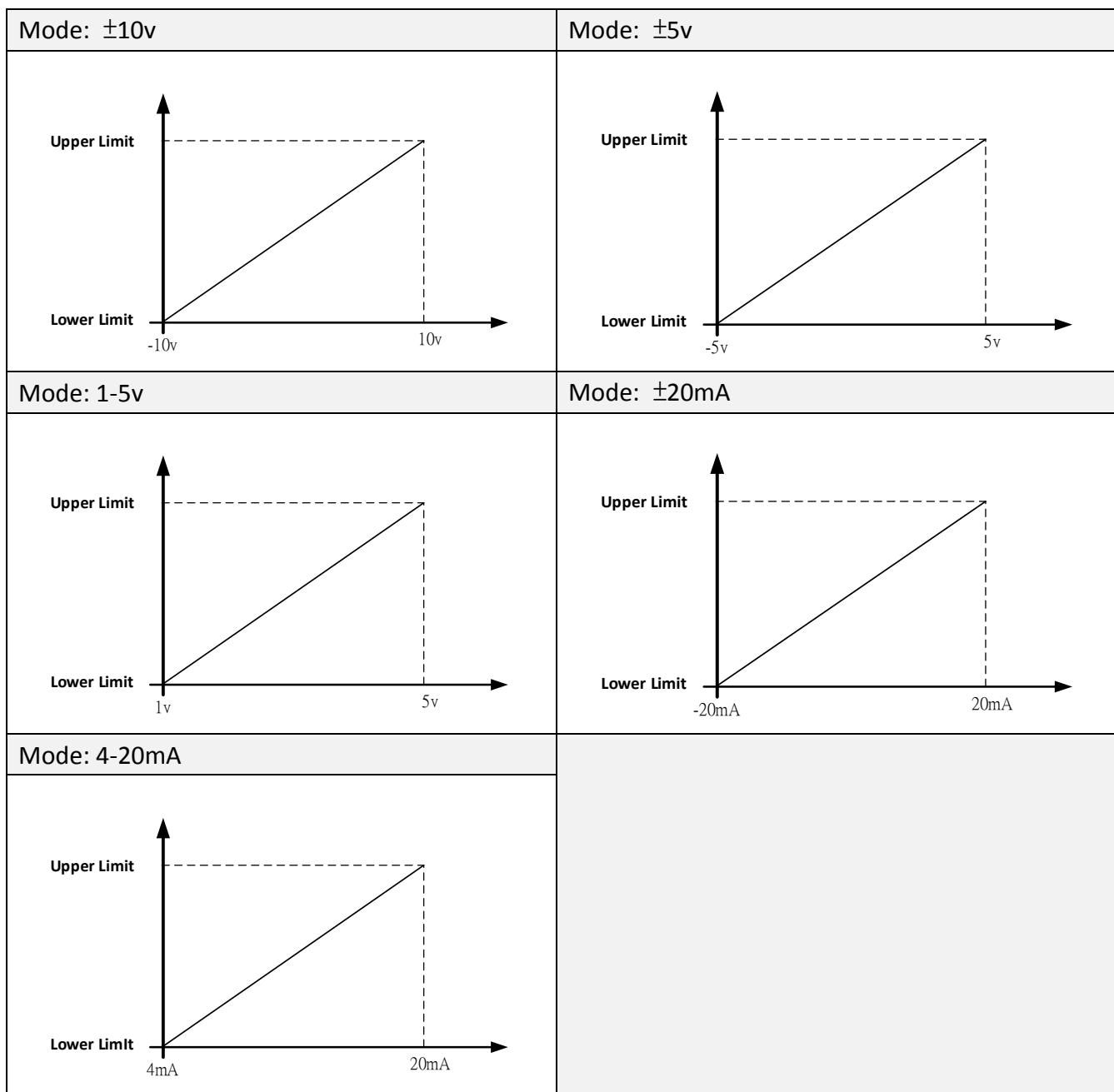
iR-Axxx-VI Series models support built-in digital-to-analog conversion with user-defined range. Available ranges are: $\pm 10V$, $\pm 5v$, 1-5v, $\pm 20m$, 4-20mA.

Example: When the defined mode is $\pm 10V$, the default scale range is ± 32000 .

Converting analog value 10v will get the upper limit of the range, which is 32000.

Converting analog value -10v will get the lower limit of the range, which is -32000.



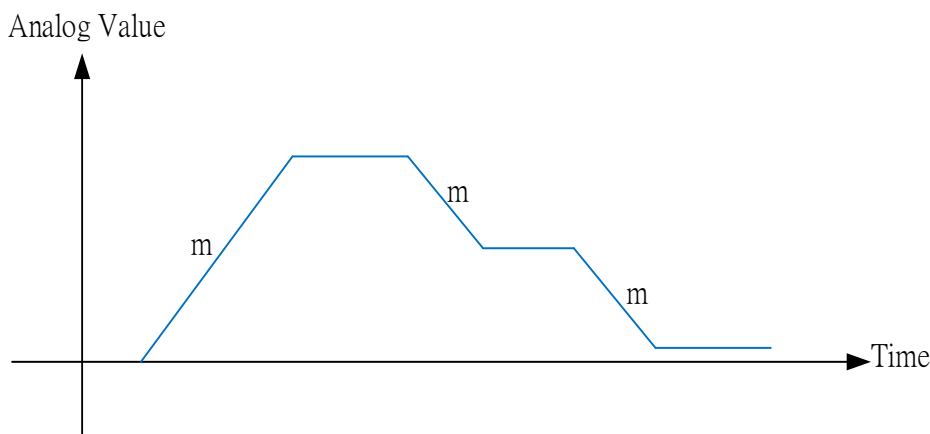
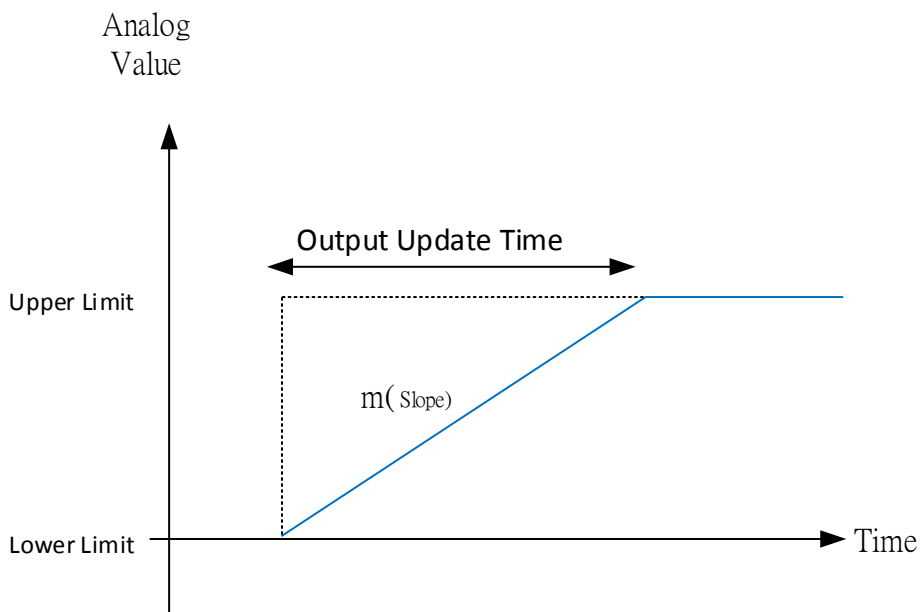


The upper and lower limit of the scale range can be configured for each mode. When switching from one mode to another, the upper and lower limit will return to default; therefore, when using this feature, please set the mode before configuring the range. By default the upper and lower limit of the range for each mode is as below:

Mode	Minimum	Maximum
-10~10V	-32000	32000
-5V~5V	-32000	32000
1~5V	0	32000
-20~20mA	-32000	32000
4~20mA	0	32000

6.3 Analog Output – Soft Start

Generally, when changing analog output value, the voltage or current output will change immediately. To gradually increase or decrease output for reducing potential system impact, an [Output Update Time] parameter can be configured. Adjusting Output Update Time can get a slew rate where the change of voltage or current from minimum to maximum value per unit of time is defined, as illustrated in the following figures.



Parameter	Description	Default
Output Update Time	The time unit is 10ms. By default this parameter is set to 0 (disabled). The maximum allowable setting is 3200 (32 seconds)	0

6.4 Analog Input – Diagnose

A channel alarm will be generated when input exceeds allowable range. In 1-5V / 4-20mA mode, disconnection can be detected when voltage is 0v or current is 0mA.

6.5 Analog Input – Fast Conversion Mode

The conversion time per channel is 2ms. The total required conversion time is calculated by multiplying 2ms by the number of channels, for example, 4 channels will take 8ms for conversion. In fast conversion mode, where only one channel is used, the conversion time can be reduced to 500us.

Fast Conversion Mode can be enabled by setting the corresponding register to 0.5ms. Under this mode, only one channel can be used. If channel 0 is not closed, the rest of the channels will not be able to perform conversion. If channel 0 is closed where channel 1 is opened, only channel 1 can perform conversion while the rest cannot.

6.6 Analog Input – Digital Filter

The built-in filter enhances signal precision to achieve better control. Setting a slower conversion rate will get a better signal quality. By default the conversion time is 2ms. Setting 60ms can effectively filter out noises in a 50/60Hz environment.

The Filter Frame Size can stabilize the signal by averaging sampled values, in order to achieve better control.

7. Registers

Address	Description	Default	Read/Write	
0	Analog Output	Channel 0 Output Mode	1	Read/Write
1		Channel 1 Output Mode	1	Read/Write
2		Channel 2 Output Mode	1	Read/Write
3		Channel 3 Output Mode	1	Read/Write
4		Channel 0 Scale Range Upper Limit	32000	Read/Write
5		Channel 1 Scale Range Upper Limit	32000	Read/Write
6		Channel 2 Scale Range Upper Limit	32000	Read/Write
7		Channel 3 Scale Range Upper Limit	32000	Read/Write
8		Channel 0 Scale Range Lower Limit	-32000	Read/Write
9		Channel 1 Scale Range Lower Limit	-32000	Read/Write
10		Channel 2 Scale Range Lower Limit	-32000	Read/Write
11		Channel 3 Scale Range Lower Limit	-32000	Read/Write
12		Channel 0 Update Time	0	Read/Write

13		Channel 1 Update Time	0	Read/Write
14		Channel 2 Update Time	0	Read/Write
15		Channel 3 Update Time	0	Read/Write
16	Error Code		0	Read
17	Command		0	Read/Write
18	Channel Detection		FFh	Read/Write
19	Analog Input	Conversion Time	0	Read/Write
20		Channel 0 Input Mode	1	Read/Write
21		Channel 1 Input Mode	1	Read/Write
22		Channel 2 Input t Mode	1	Read/Write
23		Channel 3 Input Mode	1	Read/Write
24		Channel 0 Scale Range Upper Limit	32000	Read/Write
25		Channel 1 Scale Range Upper Limit	32000	Read/Write
26		Channel 2 Scale Range Upper Limit	32000	Read/Write
27		Channel 3 Scale Range Upper Limit	32000	Read/Write
28		Channel 0 Scale Range Lower Limit	-32000	Read/Write
29		Channel 1 Scale Range Lower Limit	-32000	Read/Write
30		Channel 2 Scale Range Lower Limit	-32000	Read/Write
31		Channel 3 Scale Range Lower Limit	-32000	Read/Write
32		Channel 0 Filter Frame Size	5	Read/Write
33		Channel 1 Filter Frame Size	5	Read/Write
34		Channel 2 Filter Frame Size	5	Read/Write
35		Channel 3 Filter Frame Size	5	Read/Write
36		Channel 0 Maximum Value	0	Read
37		Channel 1 Maximum Value	0	Read
38		Channel 2 Maximum Value	0	Read
39		Channel 3 Maximum Value	0	Read
40		Channel 0 Minimum Value	0	Read
41		Channel 1 Minimum Value	0	Read
42		Channel 2 Minimum Value	0	Read
43		Channel 3 Minimum Value	0	Read

● Analog Output Mode

Value	Mode	Resolution	
0	Close Channel	N/A	
1	-10V-10V(Default)	12bit	5mV
2	-5V-5V	11bit	5mV

3	1-5v	11bit	5mV
4	±20mA	12bit	0.01mA
5	4-20mA	11bit	0.01mA

• Analog Input Mode

Value	Mode	Conversion Time	Resolution	
0	Close Channel	N/A	N/A	
1	-10V-10V(Default)	2ms	16bit	312uV
2	-5V-5V	2ms	16bit	156.25uV
3	1-5v	2ms	16bit	156.25uV
4	±20mA	2ms	16bit	0.625uA
5	4-20mA	2ms	16bit	0.625uA

• Analog Input Conversion Time

Value	Conversion Time
0	2ms
1 (Default)	2ms
2	5ms
3	10ms
4	15ms
5	25ms
6	60ms
7	0.5ms (Fast Conversion Mode)

When changing from one mode to another, the closest conversion time to 2ms x number of channels will be set. Users can adjust the conversion time to get better signal precision, for example, setting 60ms in 50/60Hz environment.

• Scale Range Setting

Setting	Description	Default
Upper Limit	Allowable range: -32768~32767	32000
Lower Limit	Allowable range: -32768~32767	-32000

Please note that setting the upper limit and lower limit to the same value will make the system use the default value.

- Analog Output Update Time

Setting	Description	Default
Analog Output Update Time	Allowable range: 0~3200 Time unit: 10ms By default this setting is disabled.	0

- Analog Input - Filter Frame Size

Setting	Description	Default
Filter Frame Size	Allowable range: 0~20 Setting value 0 will disable this setting.	5

- Analog Input maximum / minimum value

This setting keeps on recording the maximum and minimum digital value. The record can be cleared by giving a command (restart recording).

Setting	Description	Default
Input Max./Min. Value	Allowable range: -32768~32767	0

- Error Code

Bit	Description
0	Power error
1	Hardware error
2	Device isn't calibrated
3	Reserved
4	Conversion cannot be performed.
5-7	Reserved
8	Input Channel 0 error
9	Input Channel 1 error
10	Input Channel 2 error
11	Input Channel 3 error

- Command

Value	Description
0x0001	Restore factory default
0x0002	Reset the max./min. value of analog input channel 0

0x0003	Reset the max./min. value of analog input channel 1
0x0004	Reset the max./min. value of analog input channel 2
0x0005	Reset the max./min. value of analog input channel 3
0x0006	Reset the max./min. value of analog input channel 0-3

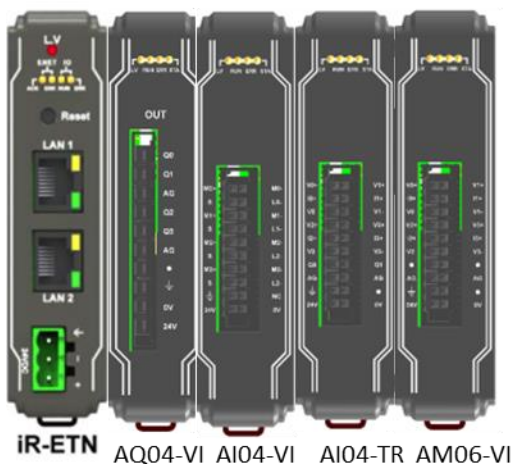
- Channel Detection

Bit	Description	Value	
		1	0
0	Analog Input Channel 0 Detection	Enable	Disable
1	Analog Input Channel 1 Detection	Enable	Disable
2	Analog Input Channel 2 Detection	Enable	Disable
3	Analog Input Channel 3 Detection	Enable	Disable
4-15	Reserved		

8. iR-ETN Coupler Address Mapping

Module No.	Module Registers	iR-ETN Modbus Address
1 st	500	20000-20499
2 nd	500	20500-20999
3 rd	500	21000-21499
4 th	500	21500-21999
.....
16 th	500	27500-27999

● Example:



Module No.	Module Name
0	iR-ETN
1	iR-AQ04-VI
2	iR-AI04-VI
3	iR-AI04-TR
4	iR-AM06-VI

Module	Module Register	iR-ETN Modbus Address
iR-AQ04-VI	0# Channel 0 Output Mode	20000
	1# Channel 1 Output Mode	20001
	2# Channel 2 Output Mode	20002
	3# Channel 3 Output Mode	20003

	16# Error Code	20016

iR-AI04-VI	20# Channel 0 Input Mode	20520
	21# Channel 1 Input Mode	20521
	22# Channel 2 Input Mode	20522
	23# Channel 3 Input Mode	20523

iR-AI04-TR	0# Channel 0 Input Mode	21000
	1# Channel 1 Input Mode	21001
	2# Channel 2 Input Mode	21002

	3# Channel 3 Input Mode	21003

iR-AM06-VI	0# Channel 0 Output Mode	21500
	1# Channel 1 Output Mode	21501

	20# Channel 0 Input Mode	21520
	21# Channel 1 Input Mode	21521
	22# Channel 2 Input Mode	21522
	23# Channel 3 Input Mode	21523

Module	Module Analog Channel		iR-ETN Modbus Address
iR-AI04-VI	Analog Input	Channel 0 Digital Value	0
		Channel 1 Digital Value	1
		Channel 2 Digital Value	2
		Channel 3 Digital Value	3
iR-AI04-TR		Channel 0 Digital Value	4
		Channel 1 Digital Value	5
		Channel 2 Digital Value	6
		Channel 3 Digital Value	7
iR-AM06-VI		Channel 0 Digital Value	8
		Channel 1 Digital Value	9
		Channel 2 Digital Value	10
		Channel 3 Digital Value	11
iR-AQ04-VI	Analog Output	Channel 0 Digital Value	256
		Channel 1 Digital Value	257
		Channel 2 Digital Value	258
		Channel 3 Digital Value	259
iR-AM06-VI		Channel 0 Digital Value	260
		Channel 1 Digital Value	261

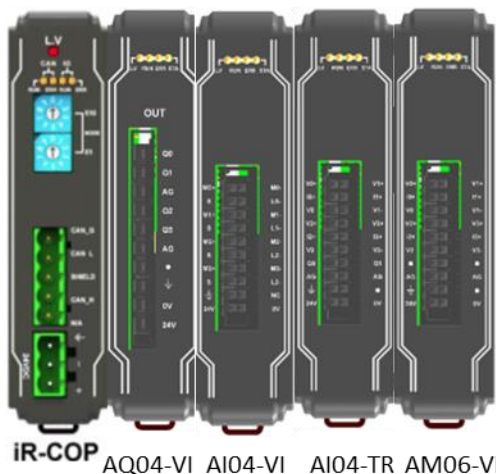
*Modbus Read Function Codes: 03h, 04h, 17h; Write Function Code: 06h, 10h, 17h

*This Modbus address starts from address 0 for CODESYS and Weintek_RemoteIO configuration. If you use common Modbus TCP/IP, the Modbus address starts from address 1 so that all parameter addresses should be increased by 1.

9. iR-COP Coupler Address Mapping

Module No.	Module Registers	Object Dictionary	
		Index	Sub-Index
1 st	127	3000h	01h-80h
2 nd	127	3001h	01h-80h
3 rd	127	3002h	01h-80h
4 th	127	3003h	01h-80h
.....	01h-80h
16 th	127	300Fh	01h-80h

● Example:



Module No.	Module Name
0	iR-COP
1	iR-AQ04-VI
2	iR-AI04-VI
3	iR-AI04-TR
4	iR-AM06-VI

Module	Module Register	Index	Sub-Index
iR-AQ04-VI	0# Channel 0 Output Mode	3000h	01h
	1# Channel 1 Output Mode	3000h	02h
	2# Channel 2 Output Mode	3000h	03h
	3# Channel 3 Output Mode	3000h	04h

	16# Error Code	3000h	10h

iR-AI04-VI	20# Channel 0 Input Mode	3001h	15h
	21# Channel 1 Input Mode	3001h	16h
	22# Channel 2 Input Mode	3001h	17h
	23# Channel 3 Input Mode	3001h	18h

iR-AI04-TR	0# Channel 0 Input Mode	3002h	01h
	1# Channel 1 Input Mode	3002h	02h
	2# Channel 2 Input Mode	3002h	03h
	3# Channel 3 Input Mode	3002h	04h

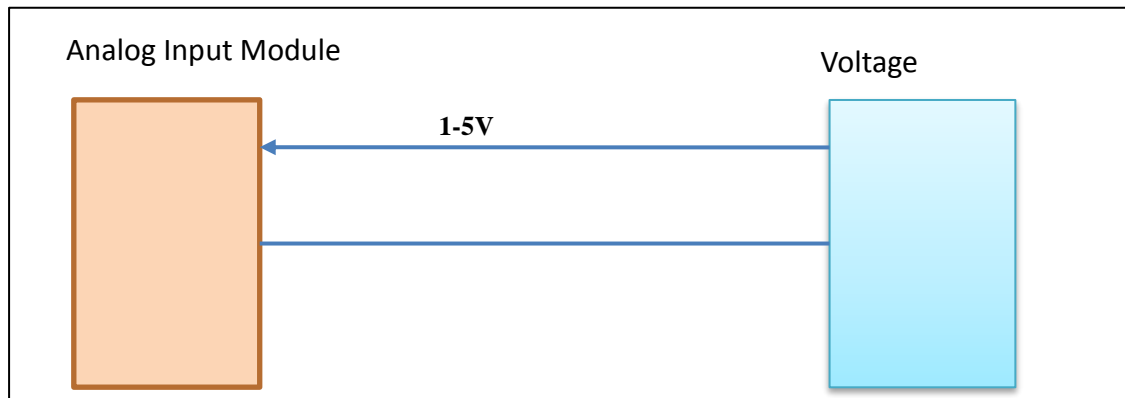
iR-AM06-VI	0# Channel 0 Output Mode	3003h	01h
	1# Channel 1 Output Mode	3003h	02h

	20# Channel 0 Input Mode	3003h	15h
	21# Channel 1 Input Mode	3003h	16h
	22# Channel 2 Input Mode	3003h	17h
	23# Channel 3 Input Mode	3003h	18h

10. Analog Channel Calibration for Value Correction

Analog input channels may experience decreased measurement accuracy caused by factors such as variations in connected loads, system aging, and component wear over time. The following example demonstrates a self-adjustment method.

- Voltage Mode Calibration



- Step 1. Channel parameter configuration:
 Set Input Mode to 1-5V mode.
 Set Input Scale Range Upper Limit to 32000.
 Set Input Scale Range Lower Limit to 0.
- Step 2. Record the lowest voltage value:
 Set the standard voltage source to output 1V and record the channel value.
- Step 3. Record the highest voltage value:
 Set the standard voltage source to output 5V and record the channel value.
- Step 4. The recorded values are as follows:

Voltage	1V	5V
Standard Value	0	32000
Actual Value	-55	31886
Error Value (Actual Value - Standard Value)	-55	-114
Lower/ Upper Limit (Standard Value - Error Value)	0- (-55)= 55	32000-(-114)=32114

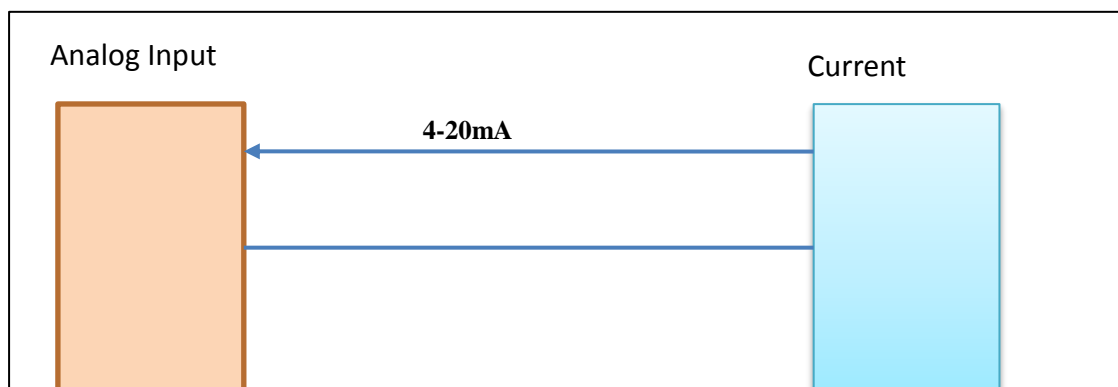
- Step 5. Calculate the Analog Value Limits = Standard Value - Error Value
 Lower Limit = 55
 Upper Limit = 32114

Step 6. Write values to the module:

ale Range Upper Limit #0	0x502c	32114
ale Range Upper Limit #1	0x502d	32000
ale Range Upper Limit #2	0x502e	32000
ale Range Upper Limit #3	0x502f	32000
ale Range Lower Limit #0	0x5030	55
ale Range Lower Limit #1	0x5031	-32000

*At this point, the input value corresponding to a 1V voltage source is 0, and the input value corresponding to a 5V voltage source is 32000.

● Current Mode Calibration



Step 1. Channel parameter configuration:

- Set Input Mode to 4-20mA mode.
- Set Input Scale Range Upper Limit to 32000.
- Set Input Scale Range Lower Limit to 0.

Step 2. Record the lowest current value:

Set the standard current source to output 4mA and record the channel value.

Step 3. Record the highest current value:

Set the standard current source to output 20mA and record the channel value.

Step 4. The recorded values are as follows:

Current	4mA	20mA
Standard Value	0	32000
Actual Value	-55	31886
Error Value (Actual Value - Standard Value)	-55	-114
Lower/ Upper Limit (Standard Value -	1- (-55)= 55	32000-(-114)=32114

Error Value)		
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Step 5. Calculate the Analog Value Limits = Standard Value - Error Value

Lower Scale Range Limit = 55

Upper Scale Range Limit = 32114

Step 6. Write values to the module:

ale Range Upper Limit #0	0x502c	32114
ale Range Upper Limit #1	0x502d	32000
ale Range Upper Limit #2	0x502e	32000
ale Range Upper Limit #3	0x502f	32000
ale Range Lower Limit #0	0x5030	55
ale Range Lower Limit #1	0x5031	-32000