Chapter 18 FB-6AD Analog Input Module

The resolution of FB-PLC analogue input (or called as A/D input) is 12 bits. The OS version of main unit before V3.2x has only 8 points of analogue input for FB-PLC (which goes together with old A/D module of FB-8AD). Starting from OS version V3.30, the analogue input can reach as many as 64 points, and its module changes to FB-6AD with new model of slim shape. Each FB-6AD has 6 points of input; therefore, it can expand upto 11 FB-6AD input modules with 64 points of analogue input in total (the last two points of the 11th module are invalid).

18.1 Specifications of FB-6AD Functions

Item			Specifications	Remark
Input points			6 points（Channels）	
Digital input value			–2048～+2047	
Span of analog input	Bipolar*	10V*	1*.Voltage: –10～10V 5. Current: –20～20mA	• There are 8 kinds of input in total, user may set by himself. * : It means the default setting.
		5V	2.Voltage: –5 ～ 5V 6. Current: –10～10mA	
	Unipolar	10V	3.Voltage: 0 ～10V 7. Current: 0～20mA	
		5V	4.Voltage: 0 ～ 5V 8. Current: 0～10mA	
Finest resolution			Voltage: 1.22mV (when input set to 0～5V) Current: 2.44μA (when input set to 0～10mA)	=Analogue input signal/4096
Accuracy			Within ±1% of full scale	
Conversion rate			Update the A/D readings every scan	
Maximum absolute input signal			Voltage: ±15V（max） Current: ±30mA（max）	It may cause the destruction to hardware if exceeds this value.
Input resistance			40KΩ (voltage input), 250Ω (current input)	
Insulation			Photocouple isolation	No isolation between channels
External power supply			24VDC±20%, Current < 200mA/@24VDC	

18.2 The Procedure of Using FB-6AD Analogue Input Module

Start

↓

Set up input voltage/current choice (V/I),unipolar/bipolar (B/U), input voltage/current range etc. jumpers setting for respective point before installation. Cascade connecting FB-6AD through the PLC expansion interface, and complete the wiring of 24VDC external power supply and analogue inputs. ------- Please refer to section 18.4 for hardware explanation.

↓

Directly access analogue input registers R3840～R3903 to acquire the analogue input value of CH0～CH63.

↓

End

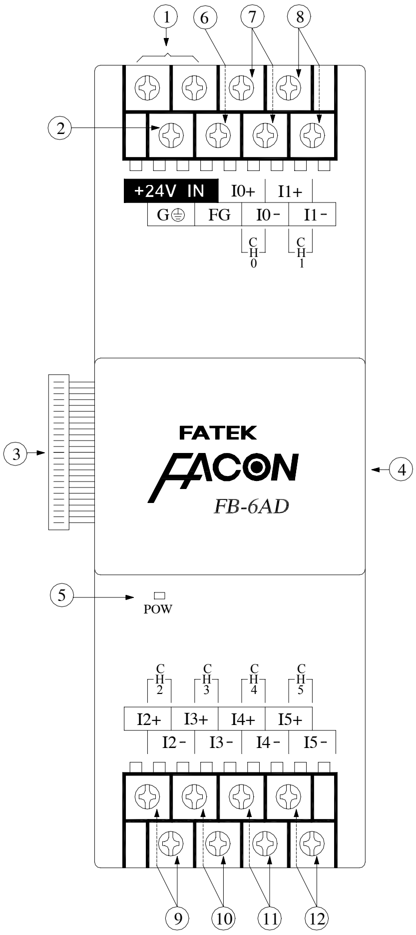
18.3 Address Allocation of FB-PLC Analogue Inputs

The memory mapping of FB-6AD inputs is beginning from the module closest to main unit, it is orderly numbered as CH0～CH5 (1st module), CH6～CH11 (2nd module), CH12～CH17 (3rd module)…… and increased with occurring order number, i.e. for each module, it adds with 6 and is totally 64 inputs from CH0～CH63, and they are corresponding to the respective internal analogue input register of PLC (so called as IR register) R3840～R3903 as listed in following table. As long as there is expanded FB-6AD module connection, the PLC main unit will automatically check to verify the quantity of FB-6AD connected, and store the respective A/D value beginning from CH0 orderly into the IR register R3840～R3903; user just access from R3840～R3093 and can acquire the corresponding input span. For the relationship between accessed value and input signal, please refer to section 18.6.

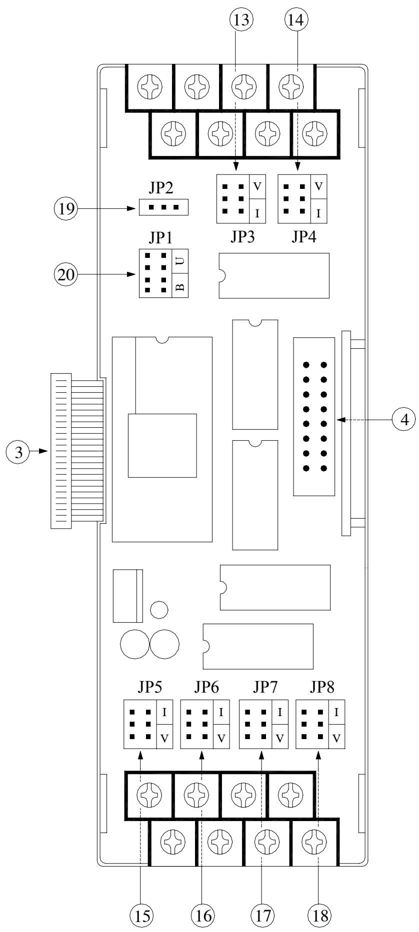
Analogue input register (IR)	Content of IR		Input label of FB-6AD	
	B_{15} B_{14} B_{13} B_{12}	B_{11} B_{10} B_9 B_8 B_7 B_6 B_5 B_4 B_3 B_2 B_1 B_0		
R3840	B_{11} B_{11} B_{11} B_{11}	B_{11} A/D value of CH0 B_0	CH0	1st module
R3841	〃	A/D value of CH1	CH1	
R3842	〃	A/D value of CH2	CH2	
R3843	〃	A/D value of CH3	CH3	
R3844	〃	A/D value of CH4	CH4	
R3845	〃	A/D value of CH5	CH5	
R3846	〃	A/D value of CH6	CH0	2nd module
R3847	〃	A/D value of CH7	CH1	
R3848	〃	A/D value of CH8	CH2	
R3849	〃	A/D value of CH9	CH3	
⋮	⋮	⋮	⋮	⋮
R3896	〃	A/D value of CH56	CH2	10th module
R3897	〃	A/D value of CH57	CH3	
R3898	〃	A/D value of CH58	CH4	
R3899	〃	A/D value of CH59	CH5	
R3900	〃	A/D value of CH60	CH0	11th module (CH4~CH5 Invalid)
R3901	〃	A/D value of CH61	CH1	
R3902	〃	A/D value of CH62	CH2	
R3903	〃	B_{11} A/D value of CH63 B_0	CH3	

(Sign extended of B_{11})

18.4 Explanation of FB-6AD Hardware



A: Outlook of top view



B: PCB top view (uncovered)

① External power input terminal: Power supply of analogue circuit for FB-6AD, the voltage can be 24VDC±20% and should be supplied with 4W of power at least.

② Protecting ground terminal: To connect to the safety Earth Ground of the power system.

③ Expansion input cable: It should be connected to the front expansion unit, or the expansion output of main unit.

④ Expansion output connector: Provides the connection for next expansion unit.

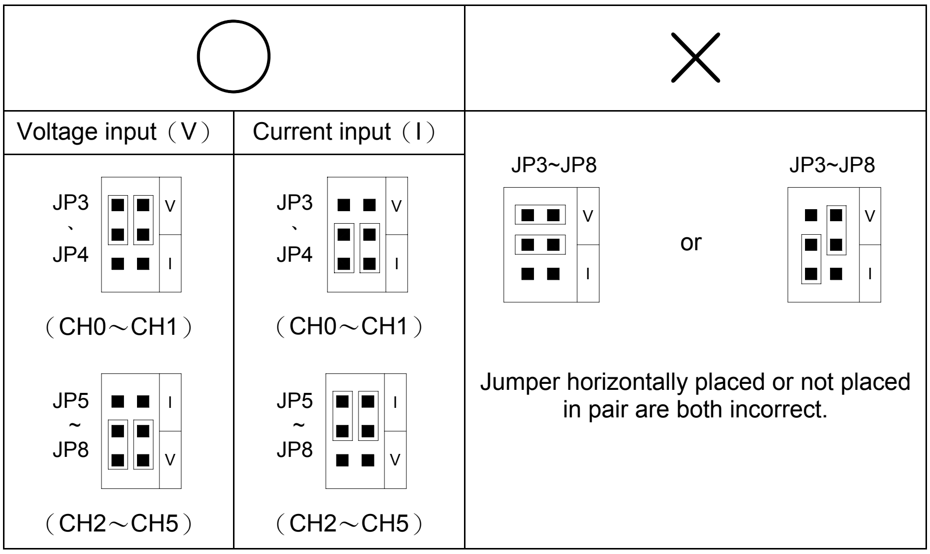
⑤ Power indicator: It indicates whether the power supply at analogue circuit and external input power source are normal.

⑥ Framing ground: To connect to the shielding of analogue input, please refer to the wiring connection diagram of next page.

⑦～⑫: Input terminal of CH0～CH5.

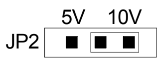
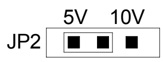
⑬～⑱: Selective jumpers of voltage(V)/current(I) for CH0～CH5.

All of the 6 analogue inputs of FB-6AD can either be voltage input or current input. The voltage or current input is sharing to use the same pair of input terminal (In+ and In–), and voltage or current is depending on the voltage(V)/current(I) jumpers pair to define (the voltage V is close to terminal side, otherwise is the current I, as shown in the JP3～JP8 of diagram B above). The V/I selective jumpers must be placed according to the text label direction (V, I are both vertically placed) to keep vertical as following diagram illustration; horizontally placed will result in error.



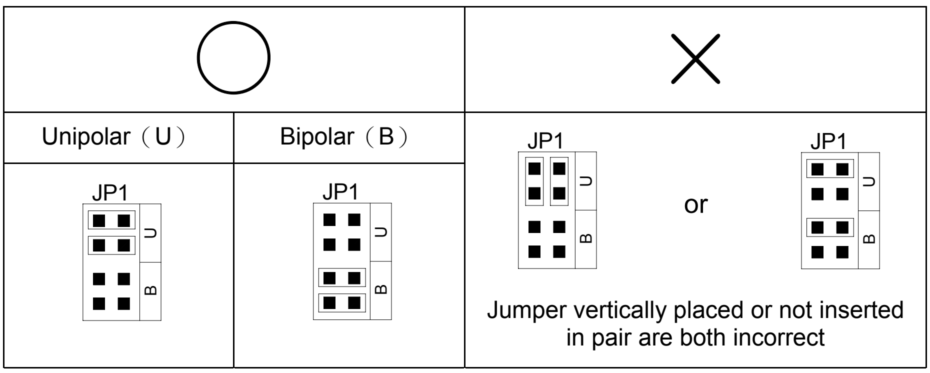
⑲ 5V/10V or 10mA/20mA selection: Maximum input span selection

All Channels must be collectively selected and can't be independently chosen.

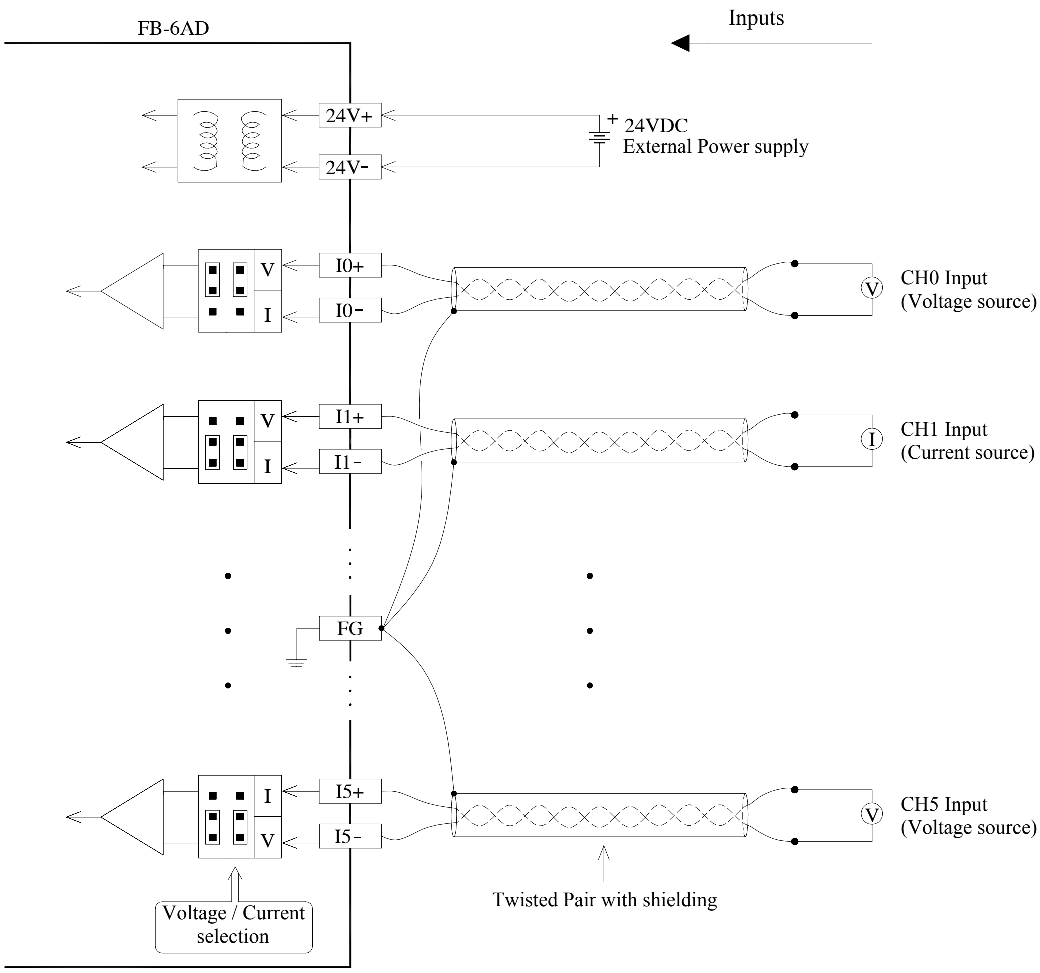
Jumper setting		10V/20mA span 	5V/10mA span 
Analogue input	Unipolar（U）	0V～10V 0mA～20mA	0V～5V 0mA～10mA
	Bipolar（B）	–10V～10V –20mA～20mA	–5V～5V –10mA～10mA

⑳ U/B selection: Unipolar (U) or Bipolar (B) selection

The jumper must according to the U/B text label direction (both B, U are horizontal) to be horizontally placed; it mustn't be vertically placed.



18.5 The Input Circuit of FB-6AD



18.6 The Input Characteristic and Jumper Setting of FB-6AD

The 8 kind of input range selections of FB-6AD must be based on the settings of V/I, U/B, 5V/10V jumpers to define, that described in previous section. Hereby it will be illustrated with diagram to explain the input conversion characteristics of B/U, 5V/10V jumpers setting (4 kind of selections). These four conversion curves incorporating V/I (voltage/ current) input setting can yield the above mentioned 8 kind of inputs. Please refer to the diagram illustration in section 18.4 for the explanation of V/I selection.

Diagram 1: Bipolar 10V (20mA) Span

Input range	Voltage	–10V～10V
	Current	–20mA～20mA

Jumper setting	JP2 5V 10V ; JP1 U B

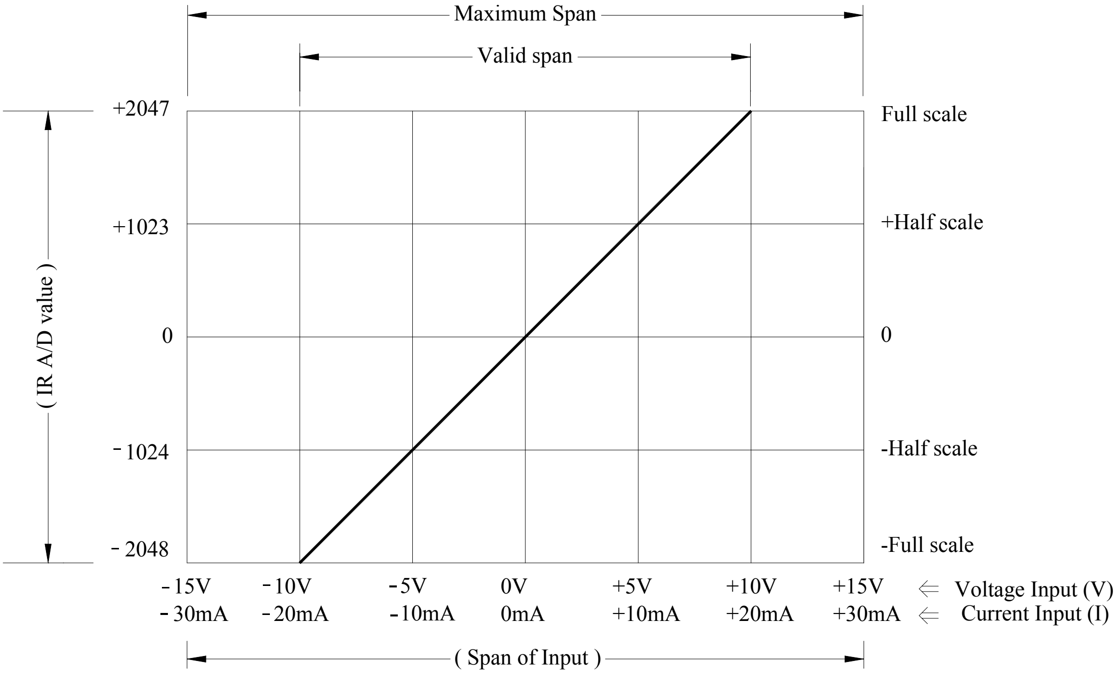


Diagram 2: Bipolar 5V (10mA) Span

Input range	Voltage	–5V～5V
	Current	–10mA～10mA

Jumper setting	JP2 5V 10V ; JP1 U B

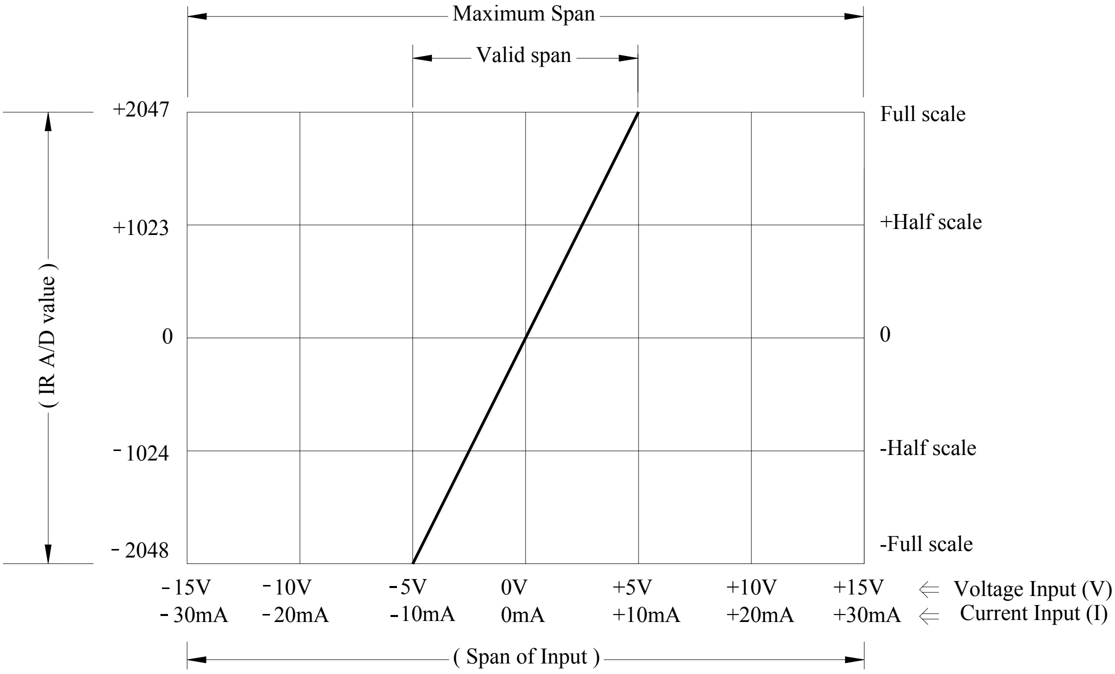
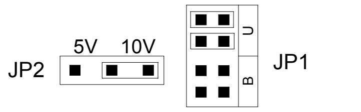


Diagram 3: Unipolar 10V (20mA) Span

Input range	Voltage	0V～10V
	Current	0mA～20mA

Jumper setting	

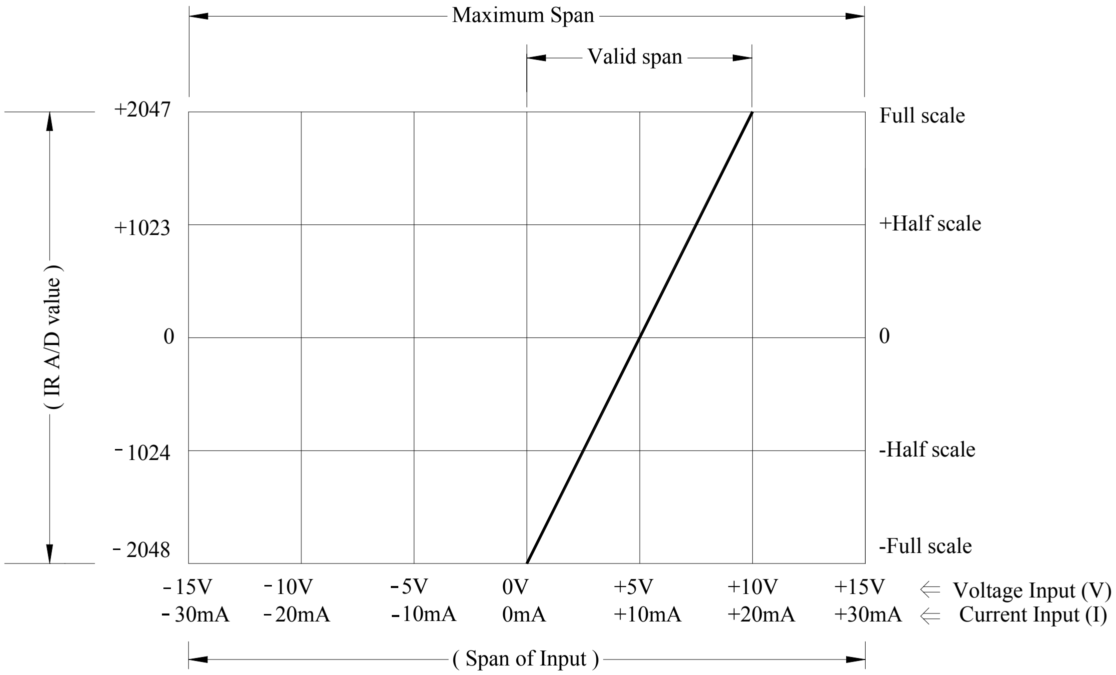
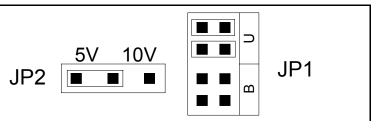
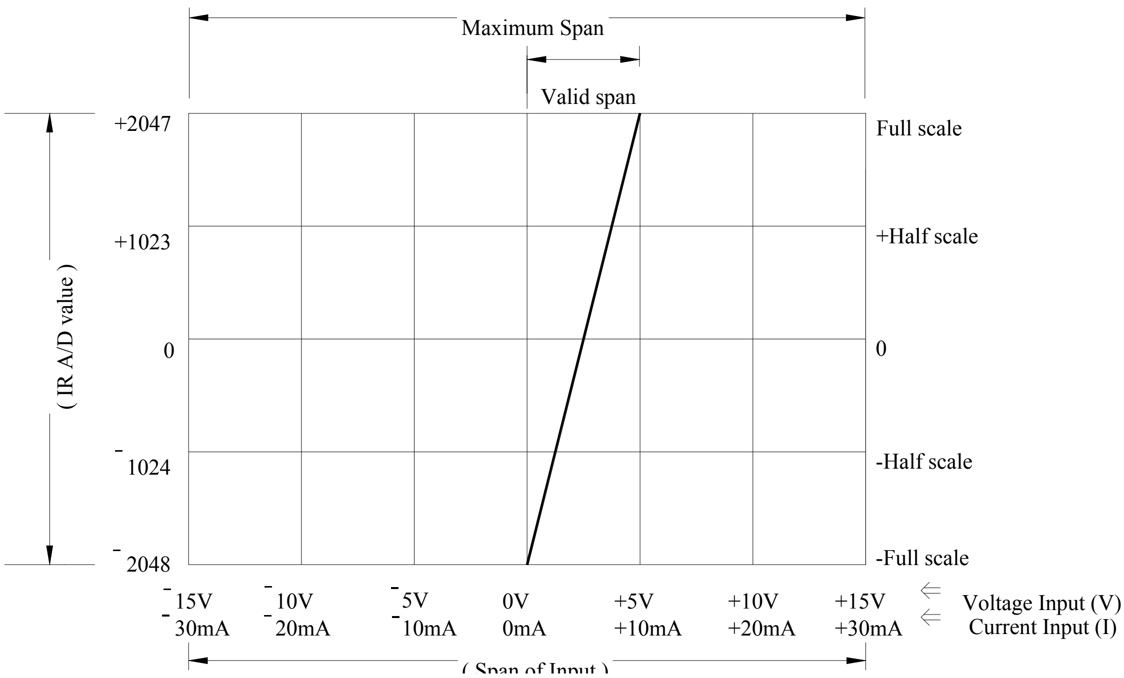


Diagram 4: Unipolar 5V (10mA) Span

Input range	Voltage	0V～ 5V
	Current	0mA～10mA

Jumper setting	



18.7 Notifications for the operation of FB-6AD

A Matching with the OS version of Main Unit and FB-6AD

FB-6AD must run on the main unit with OS version later than (include) V3.30 to work normally. If installing FB-6AD to any main unit with version before V3.30, then only the first analog input (CH0) can work normally, all other inputs will not be able to work correctly. Consequently, for main unit with version before V3.30, please use FB-8AD analogue module and can only install with one module with 8 points of analogue input totally.

Note: To tell the version of the main unit, you can just open up the cover at the center of the CPU module and see sticker with

FB-MAC V3.××

or

FB-MU V3.××

The “3.xx” is the version of main unit.

B FB-6AD can not install together with FB-4AJ(K)×× temperature module or FB-8AD analogue input module!

C The processing for Unipolar Inputs

The minimum value (0V or 0mA) should be 0 for the analogue input of unipolar, and should be 4095 for its maximum input. Nevertheless, the full resolution of 4096 of FB-6AD is expressed with −2048 (minimum) ～ 2047 (maximum), if the user intends to make it become 0～4095, it must be added with a deviation value of 2048 to IR (R3840～R3903) to acquire.

D Tackling on the OFFSET Mode Input

Confined in the limitation of space, the FB-6AD provides only normal mode for analog inputs. For the process of input for signal source of offset mode (take 4～20mA input for example), the user can set A/D input range to be 0～20mA, convert the IR value to unipolar (0～4095), lessen the offset (4mA) value (4095x4/20=819), then times the maximum input amount (20mA), and divide by the maximum span (4mA～20mA); and it can acquire the offset input conversion from 4mA～20mA reflect to 0～4095, the procedure is as follows:

a. Set the A/D input range of analogue input module to be 0～20mA.

b. Add the IR (R3840～R3903) value with 2048 and then store it into register Rn (the value of Rn is 0～4095).

c. Deduct 819 (4095x$\frac{4}{20}$) from value of register Rn, and store the calculated value back to register Rn; if the value is negative, clear the content of register Rn to 0 (the value of Rn is 0～3276).

d. The value of register Rn times 20 and then divide by 16 (Rn x $\frac{20}{16}$), and it will convert the 4mA～20mA input to range of 0～4095.

e. To sum up the items from a～d, the mathematical equation is as follows:

Offset mode conversion value = 〔IR+2048 − (4095×$\frac{4}{20}$)〕×$\frac{20}{16}$; the value is 0～4095.