

# IO Scale Factor Guidance

This topic can be complex and sometimes frustrating. I am glad that you reached out to us so that we can help with your project.

Below is a tutorial for an Analog In as an example:

The scale factor is different on AI1/2 compared with AI3/4. So, for example:

- register value of 28407 would be 1.2 V on AI1 and AI2.
- register value of 28407 would be 4.3 V on AI3 and AI4 (red and purple highlighting in the second screen shot below).

## AI1/2 Analog Input Register

To convert the register value to Volts multiply by the scale factor of 0.000152587 (purple highlighting in the two screen shots below).

## AI3/4 Analog Input Register

To convert the register value to Volts multiply by the scale factor of 0.000053406 (purple highlighting in the two screen shots below).

Attached:

### IO Unit Scale Factor Calculator:

The attached Excel Spreadsheet will assist in being able to report what the anticipated AI and AO output will be for the FGR-IO, I2-IO, and IOE/IOEX units (including when attached to ZumEdge Z9-IO-PE-ZE). The Excel sheet has the conversion factor for the AI and AO readings and will assist in reporting what the actual Modbus readings would be.

#### AI1/2

INPUT

REG

30000 30001 AI1 MSW 16 Upper 16 bits; msb=5V, Isb=152.587uV

INPUT

REG

30001 30002 AI LSW 16 Lower bits, Isb=2.3283nV

#### AI3/4

INPUT

REG

30015 30016 AI(DI1) 16 0-3.5Vin; Isb=53.406uV

Excerpt from section 7. Modbus Register Map Page 99 of the Modbus IO User Reference Manual:

Color Key					
Read Only, RO		Read/Write, RW		Non-Volatile on PWR cycle, 10,000-write lifetime limit	
Type	ADDRESS		ENTITY	BITS	NOTES
	PROTOCOL	PLC			All addresses described are "PLC" numbers
REG					
INPUT REG	30011	30012	ALL COILS 16:1	16	PLC Addresses 16:1, but Read-Only
INPUT REG	30012	30013	ALL COILS 32:17	16	PLC Addresses 32:17, but Read-Only
INPUT REG	30013	30014	AI1 MSW Offset Result	16	AI1 MSW - AI1 USER OFFSET
INPUT REG	30014	30015	AI2 MSW Offset Result	16	AI2 MSW - AI2 USER OFFSET
INPUT REG	30015	30016	AI(DI1)	16	0-3.5Vin; Isb=53.406uV
INPUT REG	30016	30017	AI(DI2)	16	0-3.5Vin; Isb=53.406uV
INPUT REG	30017	30018	AI1	32FP	IEEE754 Short Float in unscaled Volts
INPUT REG	30019	30020	AI2	32FP	IEEE754 Short Float in unscaled Volts
INPUT REG	30021	30022	AI(DI1)	32FP	IEEE754 Short Float in unscaled Volts
INPUT REG	30023	30024	AI(DI2)	32FP	IEEE754 Short Float in unscaled Volts

Example use of the attached IO Scale Factor Calculator spreadsheet:

Register Type	Register description/register	User inputs	Scale Factor	Unit of measure	16bit Result	20bit Result
Input	Analog In-put 1 (30001 msb)	8184	Register value	0.000152587 Volts	1.248772008	1.2488
			VDC	0.000152587 Volts	0	0
	Analog In-put 1 (30002 lsb)		Register value	0.000000023283 Volts	0.000000000000	
Conversion AI 1	Resistor Value	249 Ohms			5.02	Milliamps
Input	Analog In-put 2 (30003 msb)	28407	Register value	0.000152587 Volts	4.334538909	4.3345
			VDC	0.000152587 Volts	0	0
	Analog In-put 2 (30004 lsb)		Register value	0.000000023283 Volts	0.000000000000	
Conversion AI 2	Resistor Value	249 Ohms			17.41	Milliamps
Input	Analog In-put 3 (30016)	28407	Register value	0.000053406 Volts	1.52	Volts
			VDC	0.000053406 Volts	0	0
Conversion AI 3	Resistor Value	124 Ohms			12.23	Milliamps
Input	Analog In-put 4 (30017)		Register value	0.000053406 Volts	0.00	Volts
			VDC	0.000053406 Volts	0	0
Conversion AI 4	Resistor Value	124 Ohms			0.00	Milliamps
Input	Input Voltage (30009)		Register value	0.03262 Volts	0.00	Volts
			VDC	0.03262 Volts	0	0
Holding	Analog Output (40007)	50000	Register value	0.000335693 Amps	16.78	Milli Amps
			Milli Amps	0.000335693 Amps	0	0
Holding	Analog Output (40007)		Register value	0.000335693 Amps	0.00	Milli Amps