



# Modbus basic setup notes for IO-Link AL1xxx Master Block



■ Modbus has four tables/registers where data is stored along with their associated addresses. We will be using the holding registers from address 40001 to 49999 that are R/W 16 bit/Word.

- Two tables that store basic discrete values called coils (1 bit or Bool):

<b>coils - read/write</b>	<b>00001 - 09999</b>
<b>discrete inputs - read only</b>	<b>10001 - 19999</b>

- Two tables that store 16 bit numerical values called registers (16 bits or Word or INT)

<b>input registers - read only</b>	<b>30001 - 39999</b>
<b>holding registers - read/write</b>	<b>40001 - 49999</b>

■ Initial connection to the Modbus master can be used with LR Device if your firmware is v2 for the block and LRD is at least v1.3.1.120, then IoT configuration is done by a direct connection to your laptop (no switch) and then "Read" from LR Device.

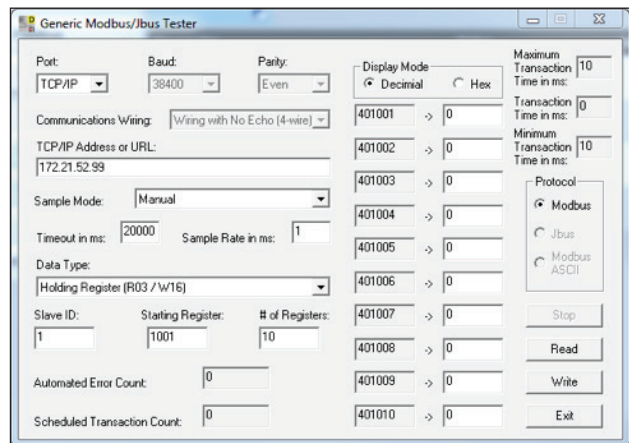
Don't forget to set your fieldbus port as well and connect both Ethernet ports. (See webserver screen shot below for details, this is the AL1340 IO Link master).

IO-Link Master 4 Port Open Modbus/TCP								
Port	Mode	Comm. Mode	MasterCycle Time	Vendor ID	Device ID	Name	Serial	
1	IO-Link	38.4 kBaud	3.9 ms	0136	000103	P12789	W0052120912	
2	Digital in	4.8 kBaud	0.0 ms	0000	000000			
3	IO-Link	230.4 kBaud	3.8 ms	0136	000338	E30443	B00501506183	
4	IO-Link							

Supervision	Value
SW-Version	3
Current	171mA
Voltage	23641mV
Short Circuit	0
Overload	0
Undervoltage	0
Temperature	47°C

Software	Version
Firmware	AL1x4x_fw_mo_f7_v2.1.32
Container	AL1x4x_cn_mo_v2.1.32
Bootloader	AL1xxx_bl_f7_v1.2.0
Fieldbus Firmware	2.6.0.5 (Open Modbus/TCP)

■ Will use a Generic Modbus tester with similar settings below to get started. If getting errors, reset power to the block, also try limiting the # of registers from 10 to 3 for example, for testing.





# Modbus basic setup notes for IO-Link AL1xxx Master Block



- Use the IP address of the Ethernet port for the Modbus tester and the IoT port for the webserver and LR Device.
- (READ EXERCISE) Hook up an IO Link sensor to a port... using PI2789 on port 1 for example. To change the port, the starting register would be 2001 for port 2, 3001 for port 3, etc... (see pg 81 of manual for details).

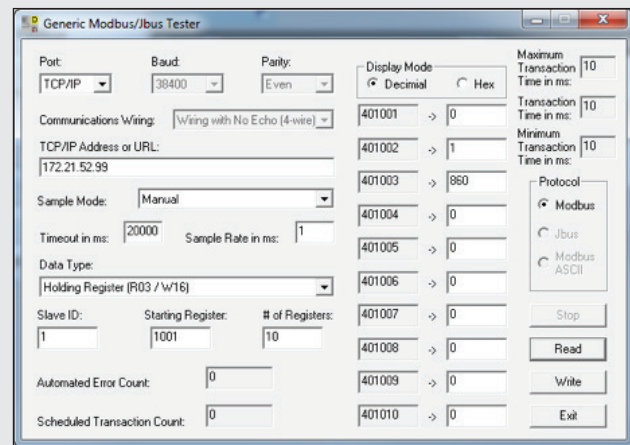
This tool requires an offset that is why we are starting at register 1001 vs 1000 for port 1 and the data will start reading on holding register 401001.

Single Port Access

Register	Contents	
	Bits 8-15	Bits 0-7
1000	Port X01: Digital Input - pin 2	Port X01: Digital Input - pin 4 (DI)
1001	reserved	Port X01: → Mapping: POI (→ p. 82)
1002	Port X01: Input Data IO-Link (n bytes)	
1100	reserved	Port X01: Digital Output - pin 4 (DO)
1101	Port X01: Output Data IO-Link (n bytes)	
2000	Port X02: Single Port Access (Mapping: → Port X01 - register 1000...1101)	
3000	Port X03: Single Port Access (Mapping: → Port X01 - register 1000...1101)	
4000	Port X04: Single Port Access (Mapping: → Port X01 - register 1000...1101)	

- In the screen shot (Modbus tester) register 401001 is 0 which means both pin 2 (bit 8) & pin 4 (bit 1) are not high. Register 401002 is 1 which means that bit 0 is high (IOL mode is enabled). Finally, register 401003 is reading 860 which is the raw data for the PI2789 (see the IODD pdf process data info below for details).

You have to divide by 4 to offset the two bits ( $860/4 = 215.0$ ). The units are in mBar and there is a gradient of 0.1 so you have to multiply by (0.1), which means the display should be reading 21.5 mbar assuming you have mbar set in the unit parameter for the PI2789.



- The process data for the PI2789

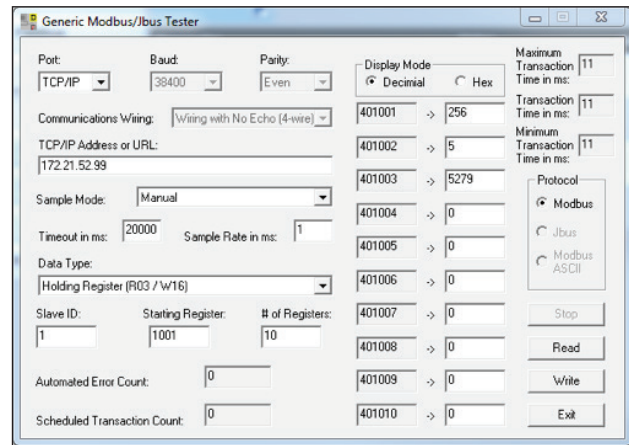
Name	Description	Datatype	Bitoffset	Bitlength	Value Range	Gradient	Offset	Unit	Single Value
Pressure	Fig. PDV1. Current system pressure. The real pressure can be calculated as follows: $P_{real} = (PDV1 \gg \text{Bitoffset}) + \text{Gradient} + \text{Offset}$ (>> means Bitshift to the right)	IntegerT	2	14	-50 to 1000	0.1	0	mbar	
Switchstate [OUT2]	Fig. BDC2. State depends on [OU2], inactive if [OU2] is set to [I] or [U].	BooleanT	1		0 to 1				
Switchstate [OUT1]	Fig. BDC1. State depends on [OU1].	BooleanT	0		0 to 1				



# Modbus basic setup notes for IO-Link AL1xxx Master Block

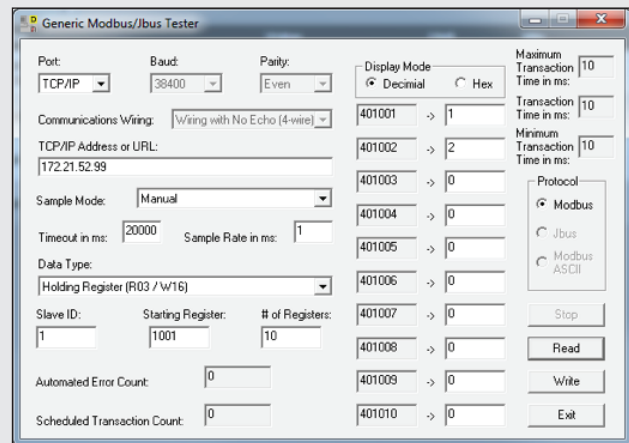


- If you were to cause the sensor to change the pressure so that pin 2 goes high, then bit 8 will go high and register 401001 will now display 256. The DI Led on the AL1340 will also turn on.

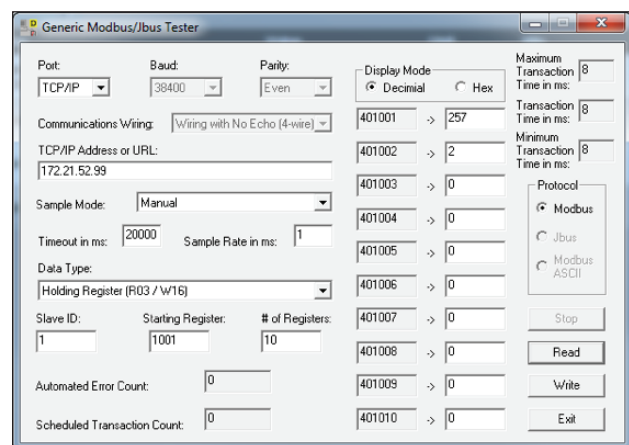


- Additionally, if you were to change port 1 from IO Link mode to a digital input and caused output 1 (pin 4) to go high then bit 0 will go on and will get a "1" in register 401001.

You will also notice register 401002 is now reading "2" vs "1" because the IO Link sensor is no longer connected. The IO Link Led on the AL1340 will also turn on.



- Finally, if you caused input 1 (pin 4 – bit 0) as well as input 2 (pin 2 – bit 8) you would then get "257" in register 401001.



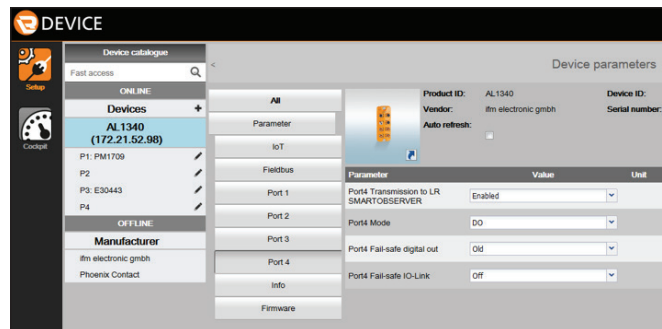
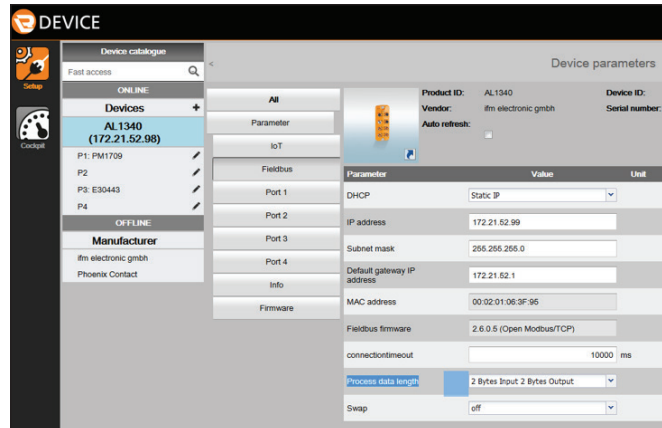


# Modbus basic setup notes for IO-Link AL1xxx Master Block



- (WRITE EXERCISE – Digital Output) In order to use the Generic Modbus Tester with a 10 register limit, we have to change the IO Link I/O size to be either 2 or 4 or 8 bytes.
- Will change port 4 to be a digital output and change the I/O size from 32 bytes to 2 bytes using line recorder device sw.

Remember, there are two IP addresses on the AL1340, use the Ethernet/fieldbus for the Generic Modbus tester and the IoT IP for LR Device and the webserver.



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## IO-Link Master 4 Port Open Modbus/TCP

Port	Mode	Comm. Mode	MasterCycle Time	Vendor ID	Device ID
1	IO-Link	38.4 kBaud	4.8 ms	0136	00029B
2	Digital in	4.8 kBaud	0.0 ms	0000	000000
3	IO-Link	230.4 kBaud	3.8 ms	0136	000338
4	Digital out	4.8 kBaud	0.0 ms	0000	000000

- From the manual on pg 42 see the register area. Register 4100 (plus 1 for offset)

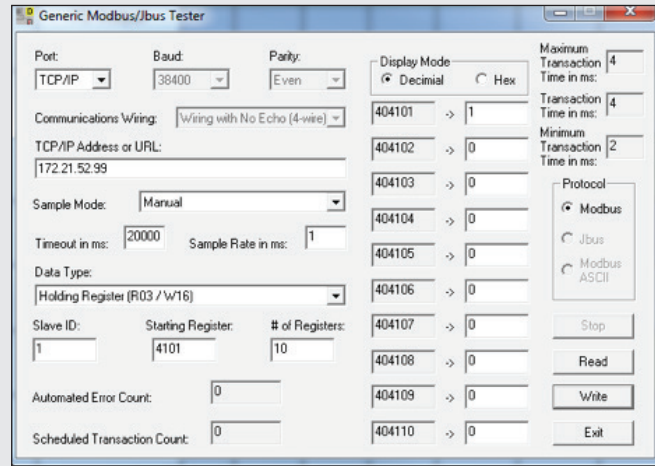
Register area		Contents	Access
Start address	Length (words)		
1100	1	Port X01: Digital Output - Pin 4 (DO)	r/w
1101	n/2	Port X01: Output Data IO-Link (n bytes)	r/w
2100	1	Port X02: Digital Output - Pin 4 (DO)	r/w
2101	n/2	Port X02: Output Data IO-Link (n bytes)	r/w
3100	1	Port X03: Digital Output - Pin 4 (DO)	r/w
3101	n/2	Port X03: Output Data IO-Link (n bytes)	r/w
4100	1	Port X04: Digital Output - Pin 4 (DO)	r/w
4101	n/2	Port X04: Output Data IO-Link (n bytes)	r/w



# Modbus basic setup notes for IO-Link AL1xxx Master Block



- From the Generic Modbus Tester will set the last bit of the first register to "1" to turn on pin 4 of port 4 on the AL1340 causing the IO Link Led to turn on and 24vdc on pin 4.



- (WRITE EXERCISE – IO Link mode)
- Will use port 3 in IO Link mode and change the I/O size from 32 bytes to 2 bytes using line recorder sw. Remember, there are two IP addresses on the AL1340, use the Ethernet/fieldbus for the Generic Modbus tester and the IoT IP for LR Device and the webserver.
- Shown below is the webserver showing port 3 and the sensor we are using is ifm p/n UA0041 which is a 4-20mA output module that is made by Phoenix Contact (p/n 2700275) and has a different name as shown. The I/O size is still set to 2 bytes from the previous exercise, so no change has been made.

**IO-Link Master 4 Port Open Modbus/TCP**

Port	Mode	Comm. Mode	MasterCycleTime	Vendor ID	Device ID	Name
1	IO-Link					
2	Digital in	4.8 kBaud	0.0 ms	0000	000000	
3	IO-Link	230.4 kBaud	2.5 ms	00B0	01003C	AXL E IOL AO1 I M12 R
4	Digital out	4.8 kBaud	0.0 ms	0000	000000	

- You can get details on the device from the website at (<https://www.phoenixcontact.com/pi/products/2700275>). The device uses output data as follows for the 4-20mA signal.

- 4mA signal.....0 (decimal) Start
- 20mA signal.....27648 (decimal) End

**13.2 S7-compatible format**  
Resolution: 1 bit (0000 -> 0008) accords 4,63 µA.

Output data	Range	4 mA ... 20 mA	
hex	dec	mA	
> 7F00	> 32512	Overrange	1.185
7EF8	32504	Overdrive range (End)	22.81
6C08	27656	Overdrive range (Start)	20.00463
6C00	27648	Nominal range (End)	20.0
3600	13824	Nominal range	12.0
0008	8	Nominal range	4.00463
0000	0	Nominal range (Start)	4.0
FFF8	-8	Underdrive range (Start)	3.995
ED00	-4864	Underdrive range (End)	1.185
< ED00	< -4864	Underrange	1.185



# Modbus basic setup notes for IO-Link AL1xxx Master Block



- Starting register for port 3 Output Data is 3101, but you have to add 1 for the Modbus Tester offset... so will enter in 3102.

Register	Contents	
	Bits 8-15	Bits 0-7
1000	Port X01: Digital Input - pin 2	Port X01: Digital Input - pin 4 (DI)
1001	reserved	Port X01: → Mapping: PQI (→ p. 82)
1002	Port X01: Input Data IO-Link (n bytes)	
1100	reserved	Port X01: Digital Output - pin 4 (DO)
1101	Port X01: Output Data IO-Link (n bytes)	
2000	Port X02: Single Port Access (Mapping: → Port X01 - register 1000..1101)	
3000	Port X03: Single Port Access (Mapping: → Port X01 - register 1000..1101)	
4000	Port X04: Single Port Access (Mapping: → Port X01 - register 1000..1101)	

- Will use an AC1422 (ASi gateway) webserver and an AC2216 (analog input module) to read the output data for verification from the UA0041 (output module).
- Starting at 0 (decimal) in the register will provide a 4mA signal. The slave information from the webserver will display this in counts  $4mA=4000$  counts (the lower value is port 2 on the slave showing 04004).