

MGate 5109 with DNP3 RTU Application

Moxa Technical Support Team
support@moxa.com

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How to Contact Moxa

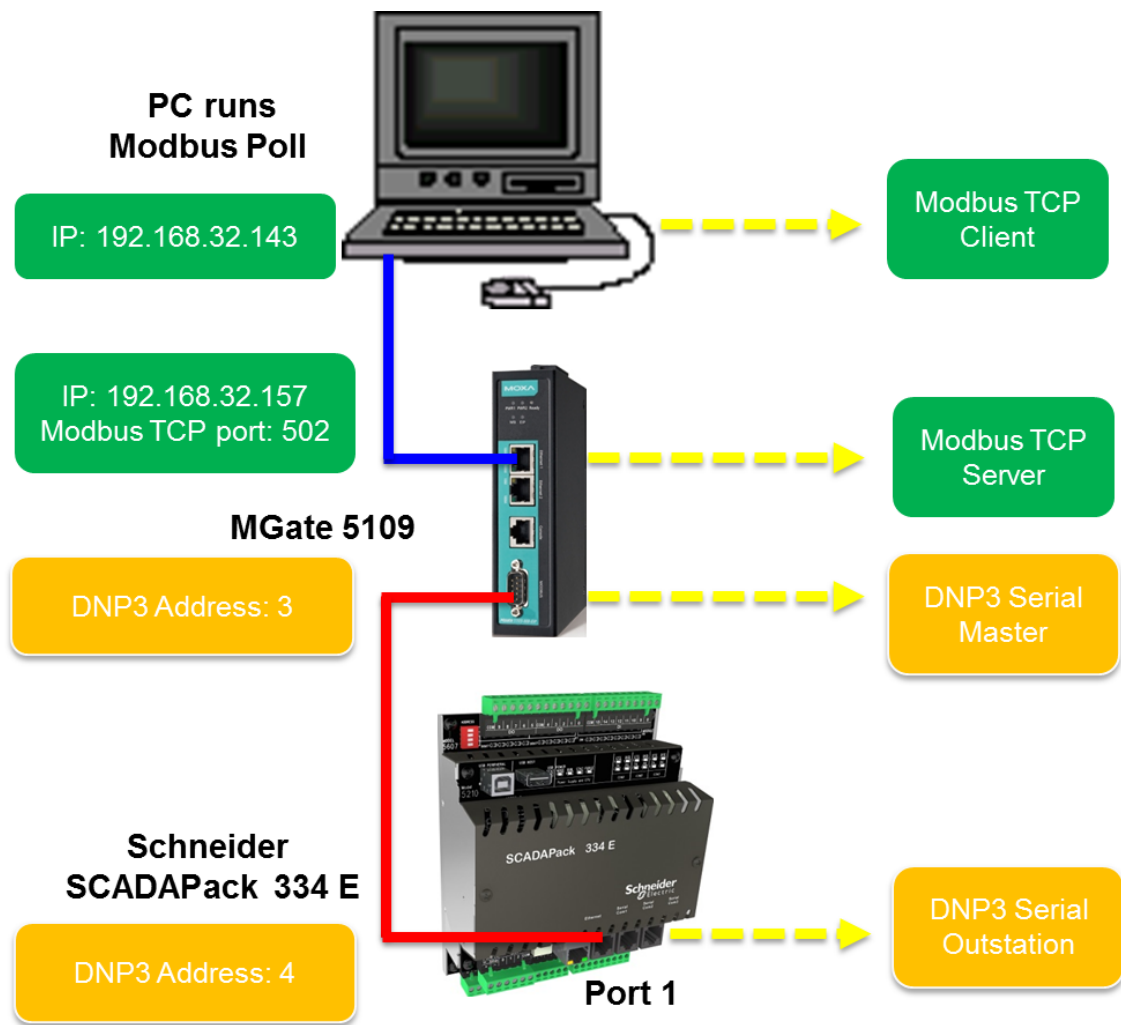
Tel: +886-2-8919-1230
Fax: +886-2-8919-1231



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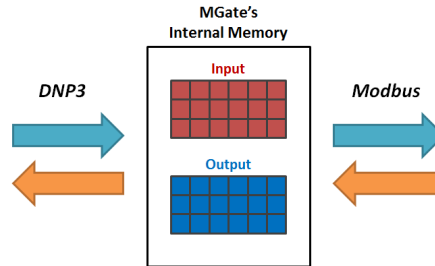
1. System Topology

This application note demonstrates how to use the **MGate 5109** to communicate with **DNP3 RTU. Schneider SCADAPack 334 E** is used as a DNP3 Serial Outstation. Its Port 1 connects to the MGate 5109 Serial Port. On the other side, a **Modbus Poll** tool acts as a Modbus TCP Client to get or remote control the DNP3 data object. The MGate 5109's protocol conversion is **Modbus TCP Server <-> DNP3 Serial Master**.



MGate 5109 works as an agent to convert Modbus to DNP3, and vice versa. In agent mode, the MGate 5109 uses an internal memory to exchange data between Modbus and DNP3.

The MGate’s internal memory is divided into two parts: one for input and the other for output, as shown in the figure below:



In order to simplify the configuration for internal memory mapping, the MGate 5109 shows the corresponding protocol address for both Modbus and DNP3 protocols, which you could find in the I/O Data Mapping. Let’s take DNP3 Binary Output as an example. Because DNP3 Binary Output can be read and written, you can find the following information, such as write Modbus coil 01 standards for BO[0] in the I/O Data Mapping page. Read **Modbus Coil 1x8193** means read the value of DNP3 BO[0]. The detail of the configuration will be explained in this technical note.

Write Operation:

- Your device: Modbus TCP Client
- Role 1 of MGate5109: Modbus TCP Server
- Role 2 of MGate5109: DNP3 Serial Master
- Your device: DNP3 Serial Outstation

Coil Address	Reg Address	Outstation	Index	Type
1x0001 - 1x0001	4x0001 - 4x0001	BO [0]	BO [0]	Value, 1 bit/point
1x0002 - 1x0002	4x0001 - 4x0001	BO [1]	BO [1]	Value, 1 bit/point

Read Operation:

- Your device: Modbus TCP Client
- Role 1 of MGate5109: Modbus TCP Server
- Role 2 of MGate5109: DNP3 Serial Master
- Your device: DNP3 Serial Outstation

Coil Address	Reg Address	Outstation	Index	Type
1x8193 - 1x8193	4x0513 - 4x0513	BO [0]	BO [0]	Value, 1 bit/point
--	4x19457 - 4x19457			Flag, 1 byte/point
1x8194 - 1x8194	4x0513 - 4x0513	BO [1]	BO [1]	Value, 1 bit/point
--	4x19457 - 4x19457			Flag, 1 byte/point

Here is a brief checklist to help you review the steps needed for a successful conversion.

	Equipment	Check items
1	DNP3 Outstation	Hardware connections. DNP3 outstation configurations. DNP3 master address setting. DNP3 outstation objects configuration: BI/BO/AI/AO/Counter.
2	MGate 5109	Hardware connections. MGate basic settings. DNP3 master address setting, same as step 1. DNP3 outstation list, object points. Modbus TCP server settings .
3	Modbus TCP Client	Modbus register address and DNP3 objects mapping table .

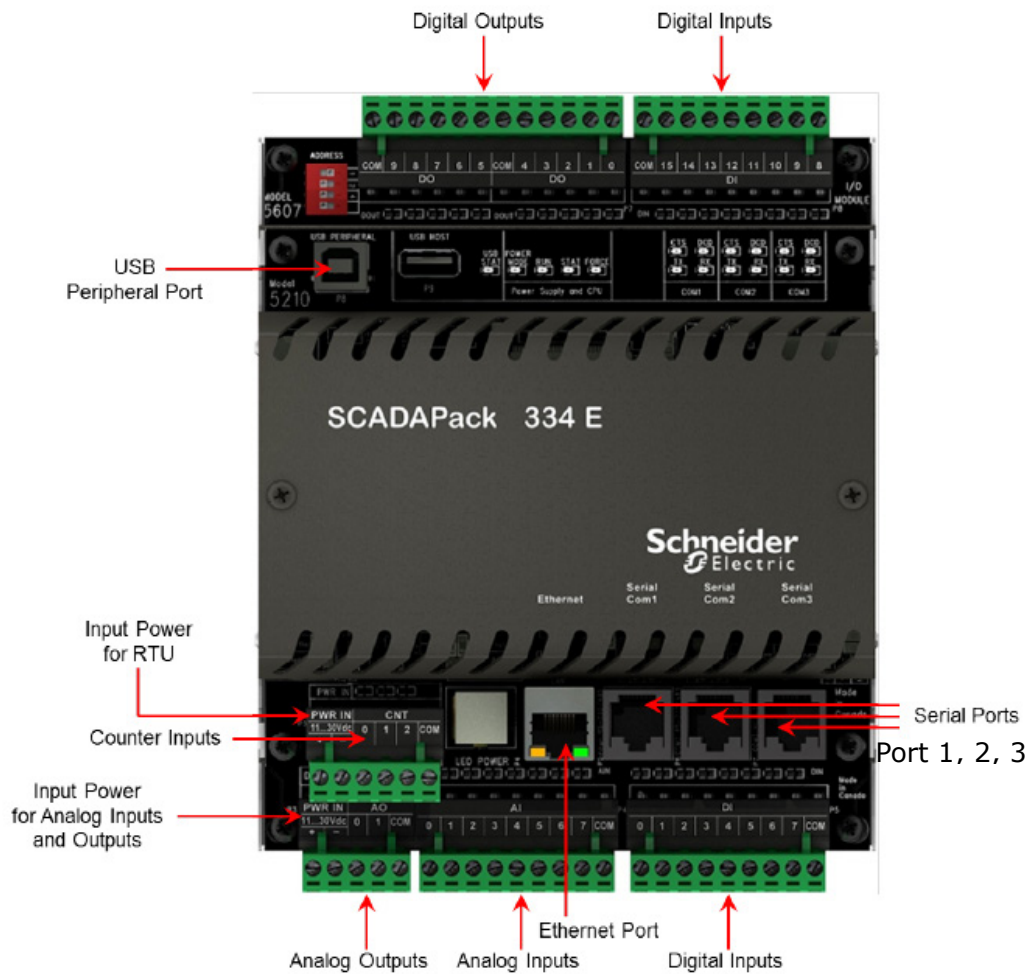
2. Required Equipment and Components

2.1. Hardware Equipment

Schneider SCADAPack 334 E:

A. Hardware Overview

The figure below illustrates Schneider’s SCADAPack 334 E outlook:



B. Inputs and Outputs

The SCADAPack 334 E hardware includes a **5210 controller board** with an integrated **5607 I/O module**. The I/O type is detailed in the following tables:

- **5607 I/O module** has the following inputs and outputs:

Input / Output Type	Description
Digital inputs	16 digital inputs
Digital outputs	10 dry contacts, digital (mechanical relay) outputs
Analog inputs	8 analog inputs
Analog outputs	2 analog outputs

- **5210 controller board** has the following inputs and outputs:

Input / Output Type	Description
Counter Inputs	3 counter inputs

2.2. Software Equipment

A. SCADAPack E Configurator:

A Windows-based software configuration tool published by **Schneider Electric**.

- 1) **Rev.:** 8.12.2
- 2) Using SCADAPack E Configurator, you can:
 - Create, modify, and delete points in the points database for the SCADAPack E
 - Download or upload files.
 - Read the current values for points
 - Configure port settings
 - Configure the DNP3 settings
 - Modify the DNP3 routing table
 - Configure features such as Data Concentrator or Modbus

B. Modbus Poll:

Modbus Poll is the very popular Modbus master simulator to test and debug your slave devices. It supports Modbus RTU/ASCII and Modbus TCP/IP.

Download Website: <http://www.modbustools.com/download.html>

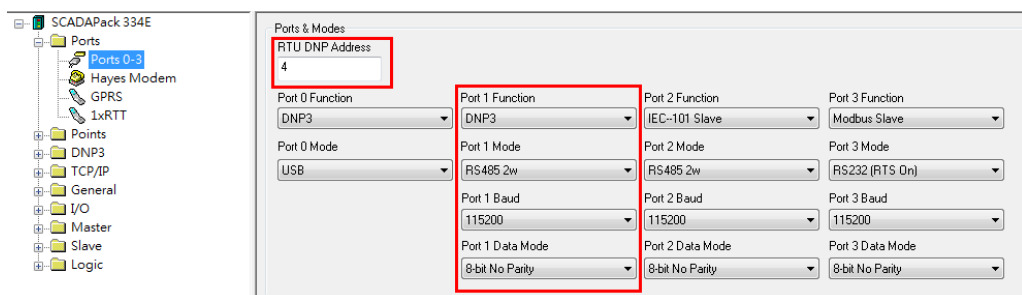
3. Schneider SCADAPack 334 E Setting

Use the **SCADAPack E Configurator** to complete the following settings:

3.1. Port Setting

In **Ports** → **Ports 0-3**:

- Set **RTU DNP Address** as **4**
- Set Port 1 **Function** as **DNP3**.
- Set Serial parameter as **RS-485 2W, Baud 115200, 8-bit No Parity**.

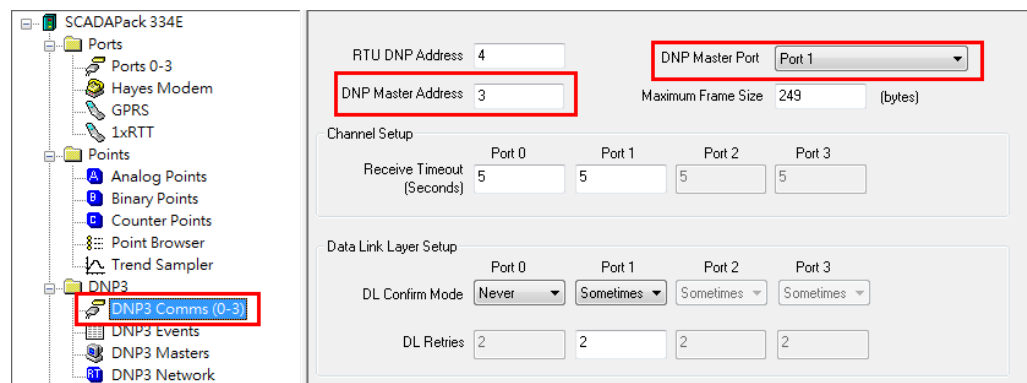


3.2. DNP3 Setting

A. DNP3 Comms

In **DNP3** → **DNP3 Comms**:

Set **DNP Master Port** as **Port 1** and **DNP3 Master Address** as **3**.



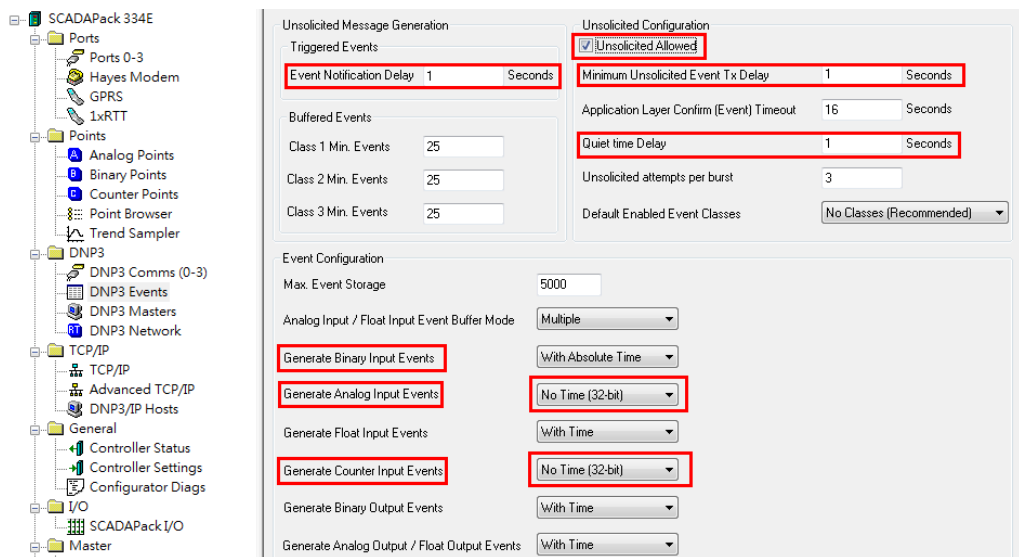
B. DNP3 Events

In **DNP3** → **DNP3 Events**:

Enable **Unsolicited Allowed** to allow Classes of Events to be reported by RTU. The DNP Master, however, can selectively enable and disable RTU Unsolicited Messages. In this demonstration, we set **Unsolicited Allowed** as **Enabled**.

Shorten **Event Notification Delay**, **Min. Unsol Event Tx Delay** and **Quiet Time Delay** to 1 second. This will shorten the event transmit interval, but it may increase data traffic.

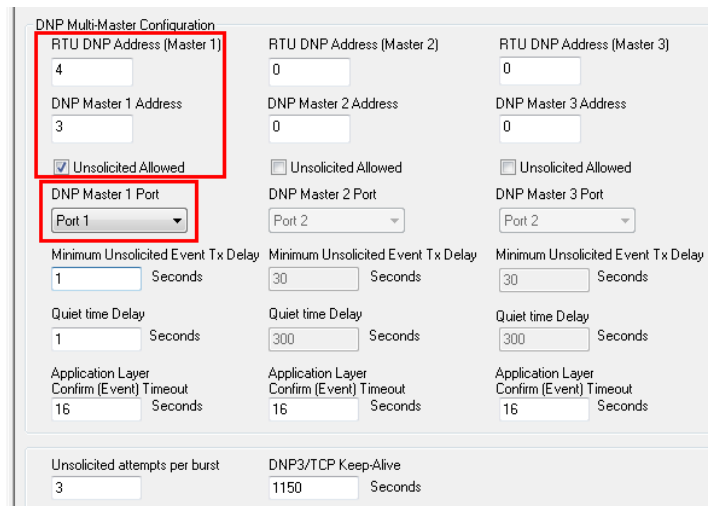
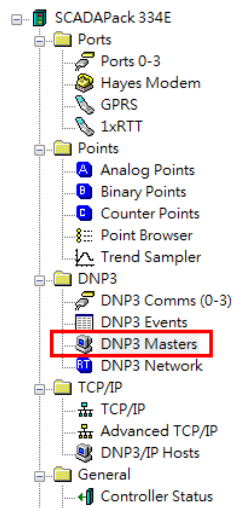
The MGate 5109 supports **DNP3 Level 2. Object Event** only supports **Binary Input Event**, **Analog Input Event** and **Counter Input Event**. **Counter Input Event** and **Analog Input Event** are not supported with timestamp object. So they are changed to **No Time (32-bit)**. They will respond to **Class Event Polling** or send **Unsolicited Message** without a timestamp.



C. DNP3 Masters

In **DNP3** → **DNP3 Master**:

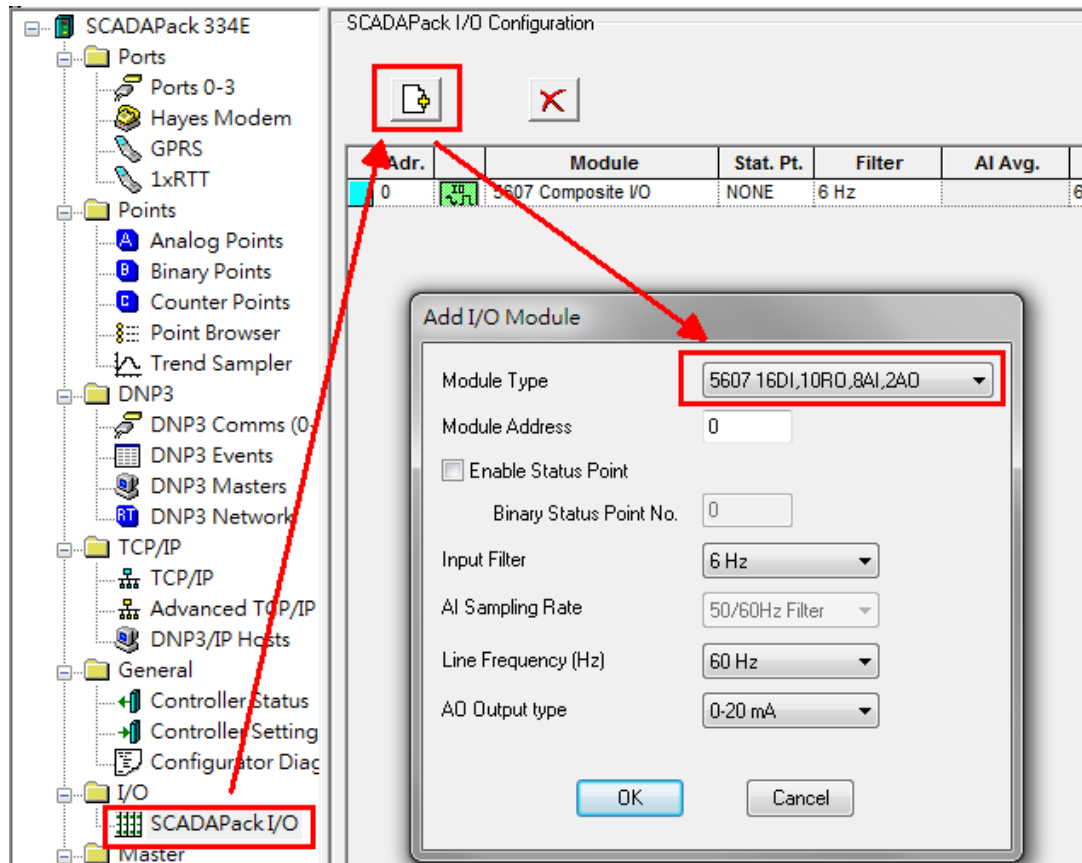
- Set **DNP Master 1 Address** as **3**.
- Enable **Unsolicited Allowed**.
- Select **Port 1** as **DNP Master 1 Port**.



3.3. I/O Setting

In **I/O** → **SCADAPack I/O**:

Click the **Add I/O Module** button and then select Module Type as **5607...**



Then modify these IO's properties as follows:

- Double-click to configure **Chan. DI0-15** as **Binary In** and **Point Num.** as **0-15**.

Chan.	Point Num.	Input Type
		Binary In
DI0	0	
DI1	1	
DI2	2	
DI3	3	
DI4	4	
DI5	5	
DI6	6	
DI7	7	
DI8	8	
DI9	9	
DI10	10	
DI11	11	
DI12	12	
DI13	13	
DI14	14	
DI15	15	

- Double-click to configure **Chan. DO0-9** as **Binary Out** and **Point Num.** as **0-9**.

	Binary Out	
DO0	0	
DO1	1	
DO2	2	
DO3	3	
DO4	4	
DO5	5	
DO6	6	
DO7	7	
DO8	8	
DO9	9	

- Double-click to configure **Chan. AI0-7** as **Analog In** and **Point Num.** as **0-7**. Input Type as **0 to 10V**.

	Analog In	
AI0	0	0 to 10V
AI1	1	0 to 10V
AI2	2	0 to 10V
AI3	3	0 to 10V
AI4	4	0 to 10V
AI5	5	0 to 10V
AI6	6	0 to 10V
AI7	7	0 to 10V

- Double-click to config **Chan. A00-1** as **Analog Out** and **Point Num.** as **0-1**.

Analog Out	
A00	0
A01	1

Add **5210 Counter Input module**, then configure **Counter In Point Num. 0-2** on **Chan. C0-2**.

Adr.	Module	Stat. Pt.	Filter	AI Avg.	Line Freq.	AI Rate	Out. Type	Chan.	Type	Point Num.
0	5210 Counter In	NONE						C0	Counter In	0
0	5607 Composite I/O	NONE	6 Hz		60 Hz		0-20 mA	C1		1
								C2		2

3.4. Points Settings

After adding **5607** and **5210 I/O Module**, **Local Points** in **Analog Points**, **Binary Points** and **Counter Points** will be added automatically.

These data points' default class is set as LOCAL. But LOCAL is not reported to the DNP3 Master. So these points needs to be changed to **Class 0-3**. Class 0 is **static data**; classes 1-3 are **event class**. Class 1 is nominally the highest priority, and class 3 is nominally the lowest.

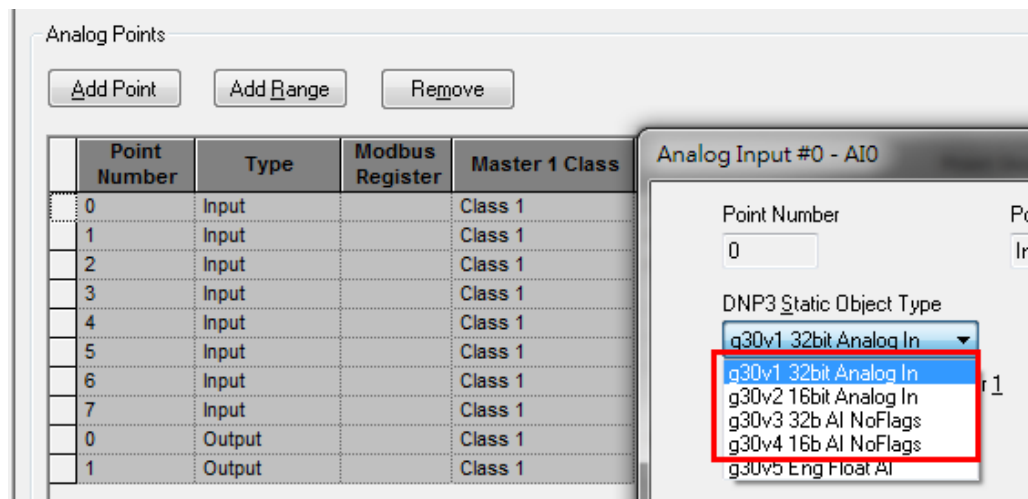
In this demonstration, we set all of data points as **Class 1**.

The screenshot displays the SCADA configuration interface. On the left, a tree view shows the project structure with 'Analog Points', 'Binary Points', and 'Counter Points' selected. The main window shows a table of points with columns for Point Number, Type, Modbus Register, and Master 1 Class. A dialog box for 'Analog Input #0 - AI0' is open, showing the 'DNP3 Point Data Class Master 1' dropdown set to 'Class 1'.

We illustrate each data object type as follows:

- **Analog Input**

The MGate 5109 supports Variation 1-4. In this demonstration, we select **g30v1 32bit Analog In**. It will respond to **Static Poll** (Class 0) with **Object Status and Flag**.



Enable **Unsolicited**. Set **Event Deviation Type** as **Percentage of Span** and **Event Deviation** as **10%**. It is used to detect changes in an analog point's current value. A significant change exceeding the deviation % specified in this attribute causes a DNP3 event to be generated.

Value Deviation _____

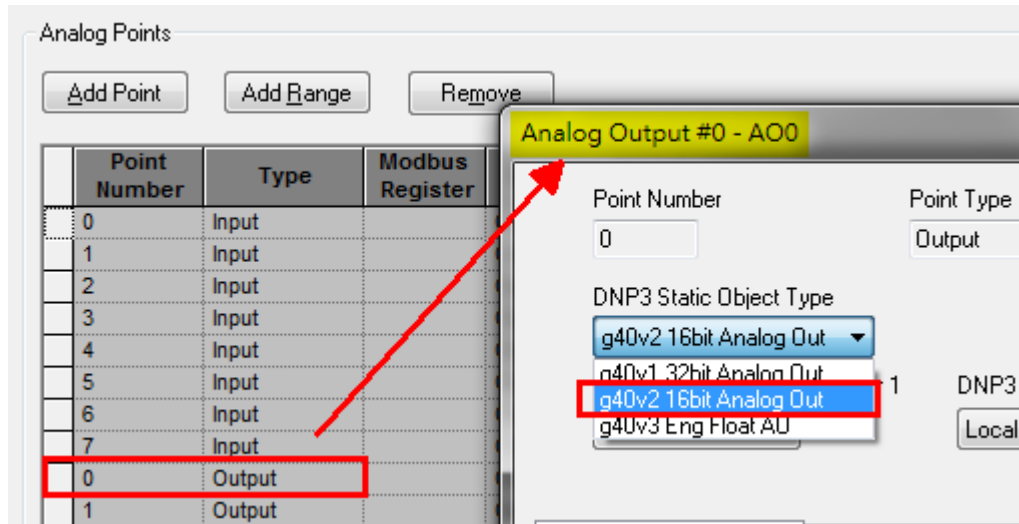
Event Deviation Type
Percentage of Span ▾

Event Deviation
10 %

Unsolicited

- **Analog Output**

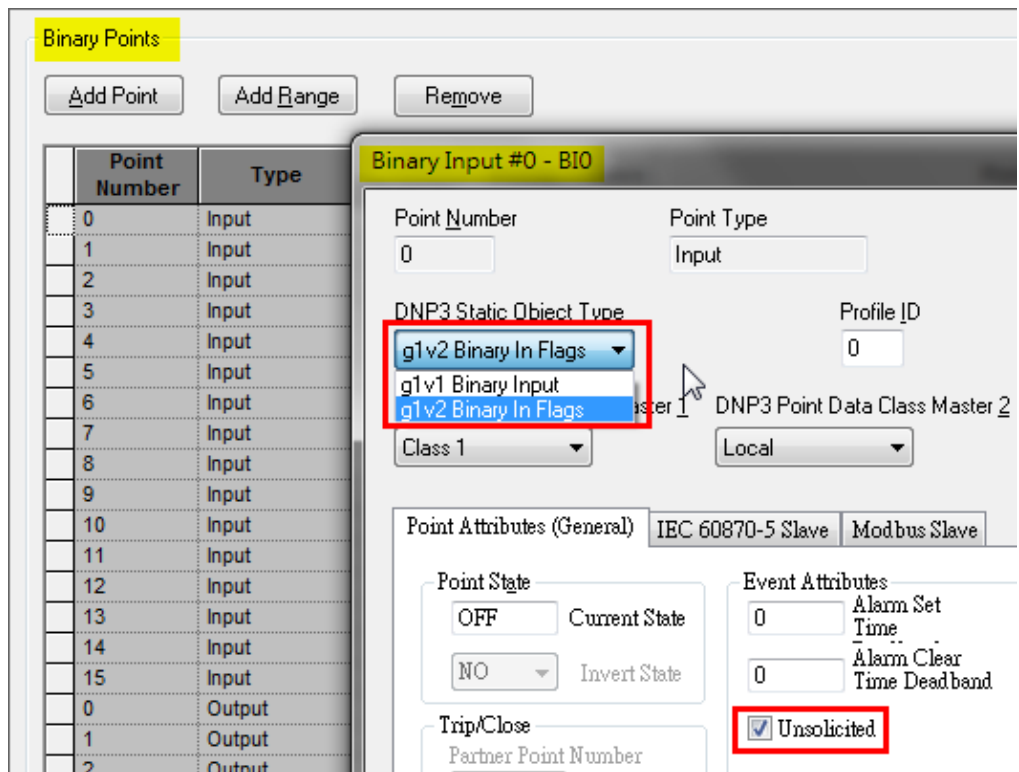
The MGate 5109 supports Variation 2. In this demonstration, we select **g40v2 16bit Analog Out**. It will respond to **Static poll** (Class 0) with **Object Status and Flag**.



- **Binary Input**

The MGate 5109 supports Variation 1, 2. In this demonstration, we select **g1v2 Binary In Flags** . It will respond to **Static Poll** (Class 0) with **Object Status and Flag**.

Enable **Unsolicited** to support sending unsolicited messages.



- **Binary Output**

The MGate 5109 supports Variation 2. In this demonstration, we select **g10v2 Binary Output**. It will respond to **Static poll** (Class 0) with **Object Status and Flag**. The MGate 5109 doesn't support **Binary Output Event**, so leave **Unsolicited** as unchecked.

The screenshot shows the configuration window for 'Binary Output #0 - BO0'. The 'Point Number' is 0 and 'Point Type' is Output. The 'DNP3 Static Object Type' is set to 'g10v2 Binary Output'. The 'Profile ID' is 0. The 'DNP3 Point Data Class Master 1' is 'Class 1' and 'DNP3 Point Data Class Master 2' is 'Local'. The 'Point Attributes (General)' tab is selected, with sub-tabs for 'IEC 60870-5 Slave' and 'Modbus Slave'. Under 'Point State', 'Current State' is OFF and 'Invert State' is NO. Under 'Event Attributes', the 'Unsolicited' checkbox is unchecked. The 'Partner Point Number' is 65535.

- **Counter Points**

The MGate 5109 supports Variation 1, 2. In this demonstration, we select **g20v1 32bit Counter**. It will respond to **Static poll** (Class 0) with **Object Status and Flag**.

The **Counter Change Deviation** attribute is used to detect changes in a counter value. A counter value change exceeding the deviation specified in this attribute causes a DNP3 event to be generated. Set it as **1**.

The screenshot shows the configuration interface for Counter Points. A table on the left lists points 0, 1, and 2, all of type 'Input'. The 'Counter #0 - CO0' dialog box is open, showing the following configuration:

Point Number	Point Type
0	Counter Input

DNP3 Static Object Type: **g20v1 32bit Counter**

DNP3 Point Data Class Master 1: Class 1

DNP3 Point Data Class Master 2: Local

Counter Value: Current Integer Value 0

Initialise On Startup: NO

Event Attributes: Counter Exceeded Point Number 0

Counter High: 0 Unsolicited

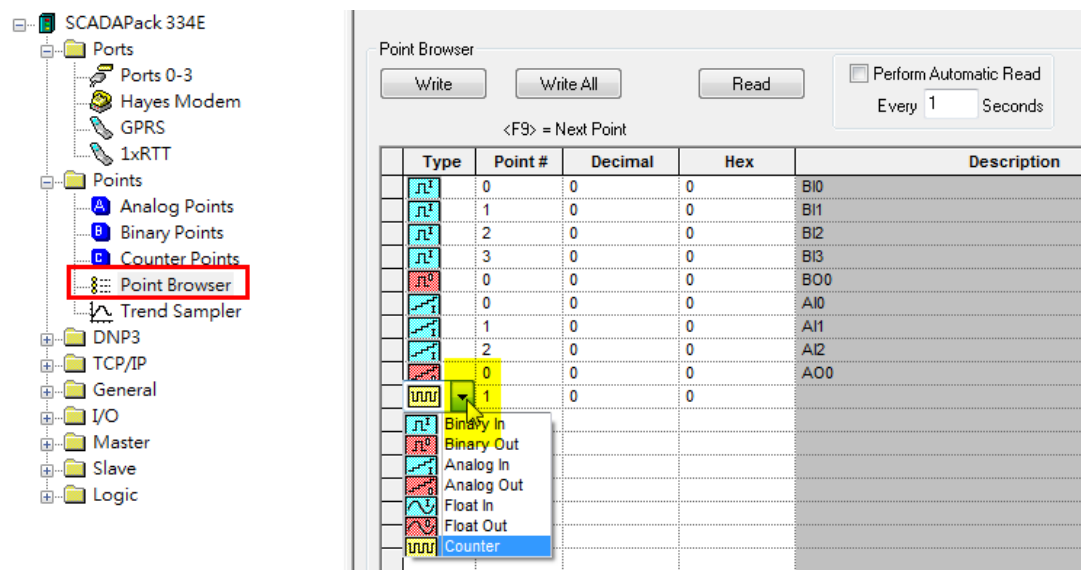
Counter Change Deviation: 1

3.5. Point Browser

The **Point Browser** allows the values of individual points to be directly read from (Static status) and written to arbitrary points (output points) in the SCADAPack E Smart RTU.

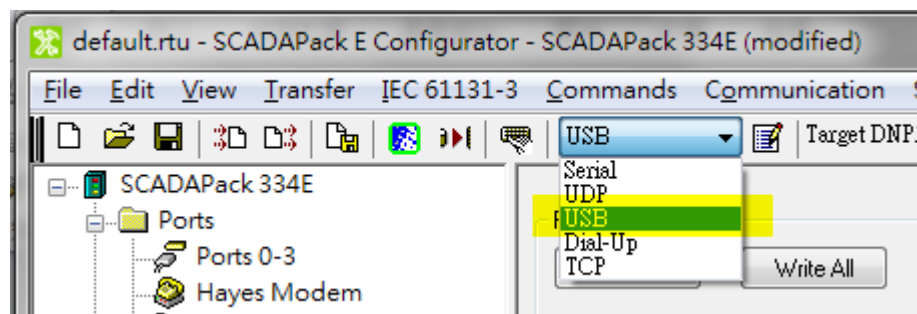
In **Points** → **Point Browser**:

Add **BI0-BI3, BO0, AI0-2, AO0, CO0** to monitor. Enable **Perform Automatic Read** to every **1** second.

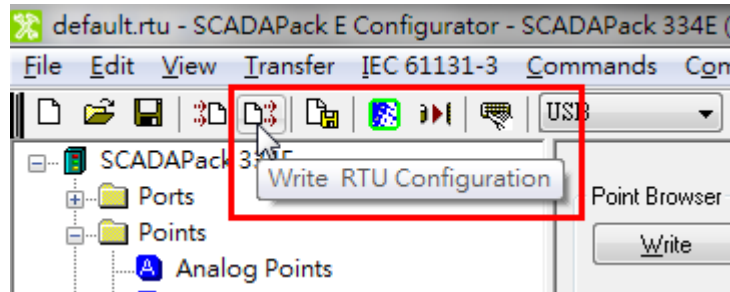


3.6. Write config

Use a USB cable to connect to the **Schneider SCADAPack 334 E USB Port**. Select the communicate interface as **USB**.



On completion of all the settings, click the **Write RTU Configuration** button to download configuration to the **Schneider SCADAPack 334 E**.



4. MGate 5109 Setting

Log in to the MGate 5109’s web console, and complete the following settings.

4.1. Serial Settings

Set as below:

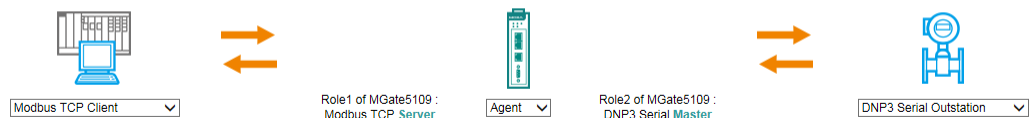
Serial Settings

Port	Baud rate	Parity	Data bit	Stop bit	Flow control	FIFO	Interface
1	115200	None	8	1	None	Enable	RS-485 2-wire

4.2. Protocol Conversion

Set as below:

Protocol Conversion



4.3. DNP3 Settings

Under **DNP3 Serial Master Settings**, set **DNP3 master address** as **3**.

Master Settings

DNP3 master address (0 - 65519)

In **Outstation List**, click **Add** to add **DNP3 Outstation** and set as below:

Outstation List

+ Add
✎ Edit
📄 Clone
🗑 Delete
↕ Move

Index	Name	DNP3 Address	Binary Input points	Binary Output points	Counter points	Analog Input points	Analog Output points
0	SCADAPack334E	4	0-15	0-9	0-2	0-7	0-1

- Set **Unsolicited Message** as **Enable** to accept the outstation’s unsolicited responses.
- Set **Polling all class 0 static points** as **At start up only** to poll the status of all data objects when the DNP3 Outstation is connected.
- Because **Unsolicited Message** and the outstation’s Unsolicited are enabled, class 1-3 events are not polled.

Basic Settings

Name	SCADAPack334E
DNP3 data link address	4 (0 - 65519)
Unsolicited Message	Enable ▾
Polling all class 0 static points	At start up only ▾
Polling class 1 events	None ▾
Polling class 2 events	None ▾
Polling class 3 events	None ▾

Configure **IO Objects "Points Index"** and add the object commands as follows:

Object	Points Index	Commands
Binary Input	0-15	-
Binary Output	0-9	Read Binary Output
Counter	0-2	Read Counter
Analog Input	0-7	Read Analog Input
Analog Output	0-1	Read Analog Output

DNP3 Level2 doesn’t support **Binary Output** and **Analog Output** event, so these objects are polled as follows:

Read Binary Output:

+ Add
✎ Edit
📄 Clone
🗑 Delete

Function code	Group	Variation	Qualifier	Polling interval (ms)
Read	10: Binary output	0: Any Variation	06: All points	5000

Read Analog Output:

+ Add
✎ Edit
📄 Clone
🗑 Delete

Function code	Group	Variation	Qualifier	Polling interval (ms)
Read	40: Analog Output	0: Any Variation	06: All points	5000

Because we set SCADAPack 334 E's Analog Input functions **Event Deviation Type** and **Event Deviation** as **Percentage of Span** and **10%**, respectively, it doesn't achieve trigger level and therefore does not send any unsolicited messages. Use polling to read the status of **Analog Input** as below:

Function code	Group	Variation	Qualifier	Polling interval (ms)
Read	30: Analog input	0: Any Variation	06: All points	5000

Under **Binary Object** setting, we can set the **CROB** parameters by selecting **Function code** or **Control models**.

Default CROB parameters

Index	Function code	Control models	Object count	On time (ms)	Off time (ms)
0	3/4: Select-Operate	Latch on-off model			
1	3/4: Select-Operate	Close-trip model	3	5000	5000
2	3/4: Select-Operate	Activation model	3	5000	5000
3	3/4: Select-Operate	Latch on-off model			
4	3/4: Select-Operate	Latch on-off model			
5	3/4: Select-Operate	Latch on-off model			
6	3/4: Select-Operate	Latch on-off model			
7	3/4: Select-Operate	Latch on-off model			
8	3/4: Select-Operate	Latch on-off model			
9	3/4: Select-Operate	Latch on-off model			

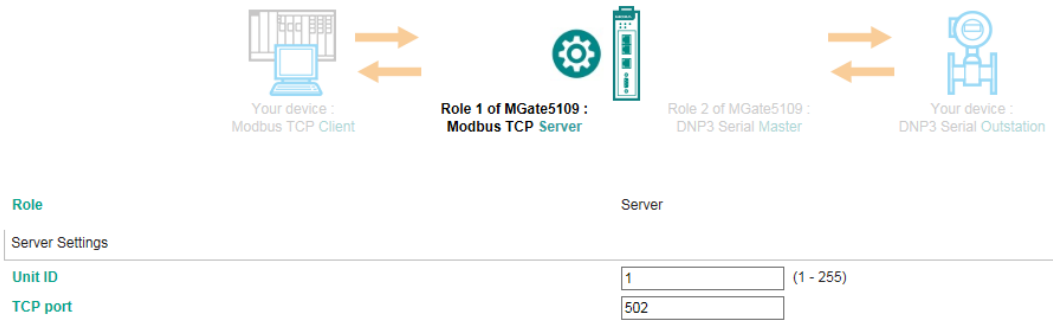
The SCADAPack 334 E supports **trip/close pulse controls, On-time, Off-time** and **Count fields**.

In this demonstration, BO 1's **Control model** is **Close-trip model**. When BO1 triggers **Off→On** (by Modbus TCP client), the SCADAPack 334 E's BO 1 will pulse **On-time** for 5000 ms and then pulse **Off-Time** 5000 ms for three cycles. The status will stay **Off** until the next command. In this demonstration, BO 2's **Control model** is **Activation model**. When BO2 triggers **Off-→On** (by Modbus TCP client), the SCADAPack 334 E's BO 2 will pulse **On-time** for 5000 ms and then pulse **Off-Time** 5000 ms for three cycles. It will keep the status as **Off** until the next command. In the MGate 5109's **Activation model** design, the CROB's value on the MGate 5109 Internal Memory will be changed to **Off**. So with the next trigger just write this memory as **On** and then it will trigger CROB, using **Activation model**.

4.4. Modbus TCP Setting

Set as below:

Modbus TCP Settings



5. Modbus Poll Setting

The MGate 5109 uses an internal memory to exchange data between Modbus and DNP3. Some data objects mapping address examples are shown below:

Data flow direction: Modbus TCP Client → DNP3 Serial Outstation

DNP3 Data object	Modbus		Internal Address (DEC)	Internal Address (HEX)
	Coil Address	Register Address		
CROB 0	1		0	0
CROB 1	2		0	0
AO Cmd 0		513	64	40
AO Cmd 1		514	64	40

Data flow direction: DNP3 Serial Outstation → Modbus TCP Client

DNP3 Data object	Modbus		Internal Address (DEC)	Internal Address (HEX)
	Coil Address	Register Address		
BI 0	1		0	0
BI 1	2		0	0
BO 0	8193		1024	400
BO 1	8194		1024	400
Counter 0		1025	2048	800
Counter 1		1027	2052	804
AI 0		9217	18432	4800
AI 1		9219	18436	4804
AO 0		13313	26624	6800
AO 1		13314	26626	6802

PC runs **Modbus Poll** to connect to the MGate 5109's TCP 502 port. According **I/O Data Mapping**, add the command definition as follows:

5.1. Read BI Status Definition

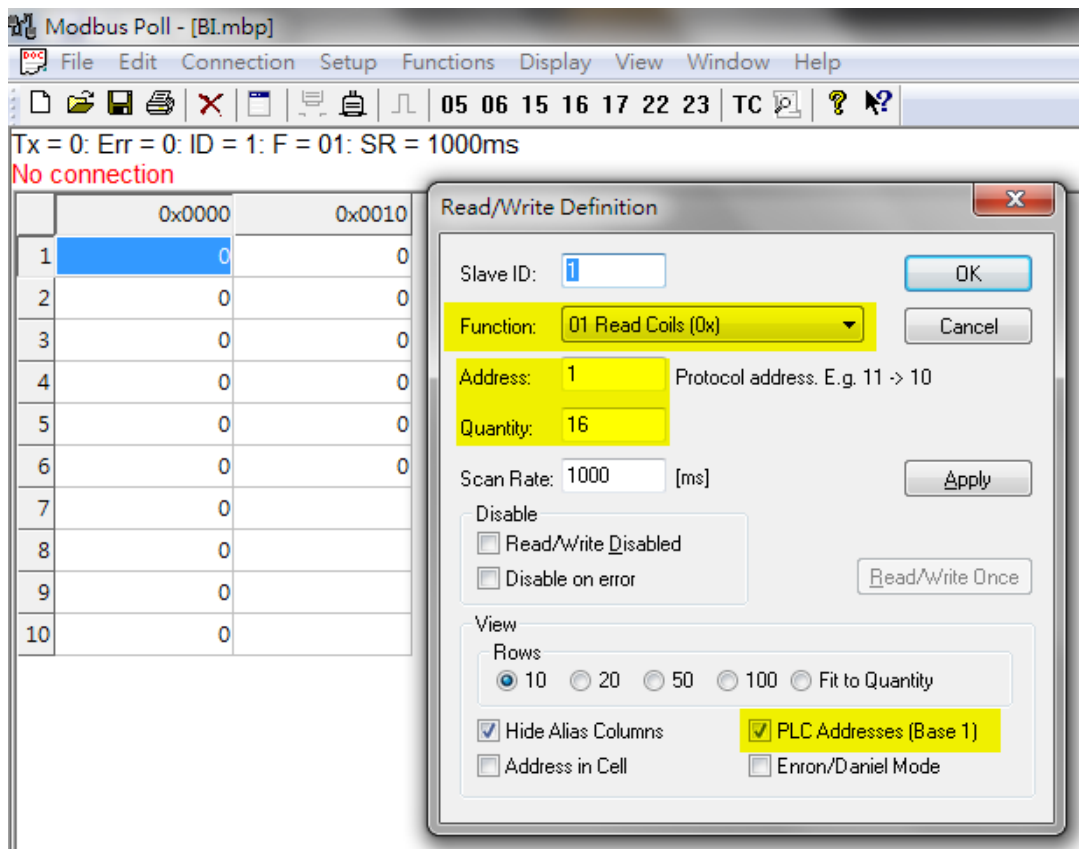
BI I/O Data Mapping:

: mapped index : un-mapped index

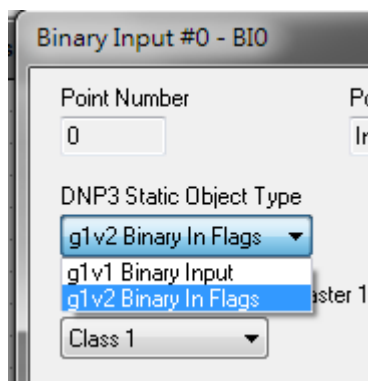
Coil Address	Reg Address
1x0001 - 1x0001	4x0001 - 4x0001
--	4x15361 - 4x15361
--	4x27649 - 4x27651
1x0002 - 1x0002	4x0001 - 4x0001
--	4x15361 - 4x15361
--	4x27652 - 4x27654
1x0003 - 1x0003	4x0001 - 4x0001

Outstation	Index	Type
		Value, 1 bit/point
BI [0]		Flag, 1 byte/point
		Event Time, 6 byte/point
		Value, 1 bit/point
BI [1]		Flag, 1 byte/point
		Event Time, 6 byte/point
		Value, 1 bit/point

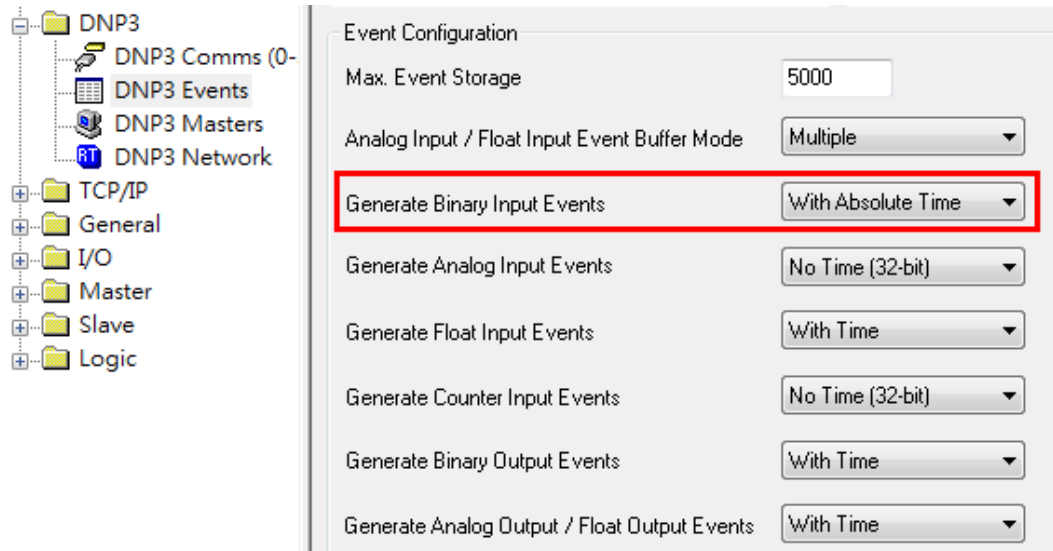
BI Status Command Definition:



When the BI Static Object is with a flag, the MGate 5109 uses **class 0 static poll** to update the status of the **Flag**.




When RTU's BI sends Unsolicited Message, the MGate 5109 will update the **Flag** status and the **Event Time**.




5.2. Read BO Status Definition


BO I/O Data Mapping:




Your device :
Modbus TCP Client




read



Role 1 of MGate5109 :
Modbus TCP Server



read



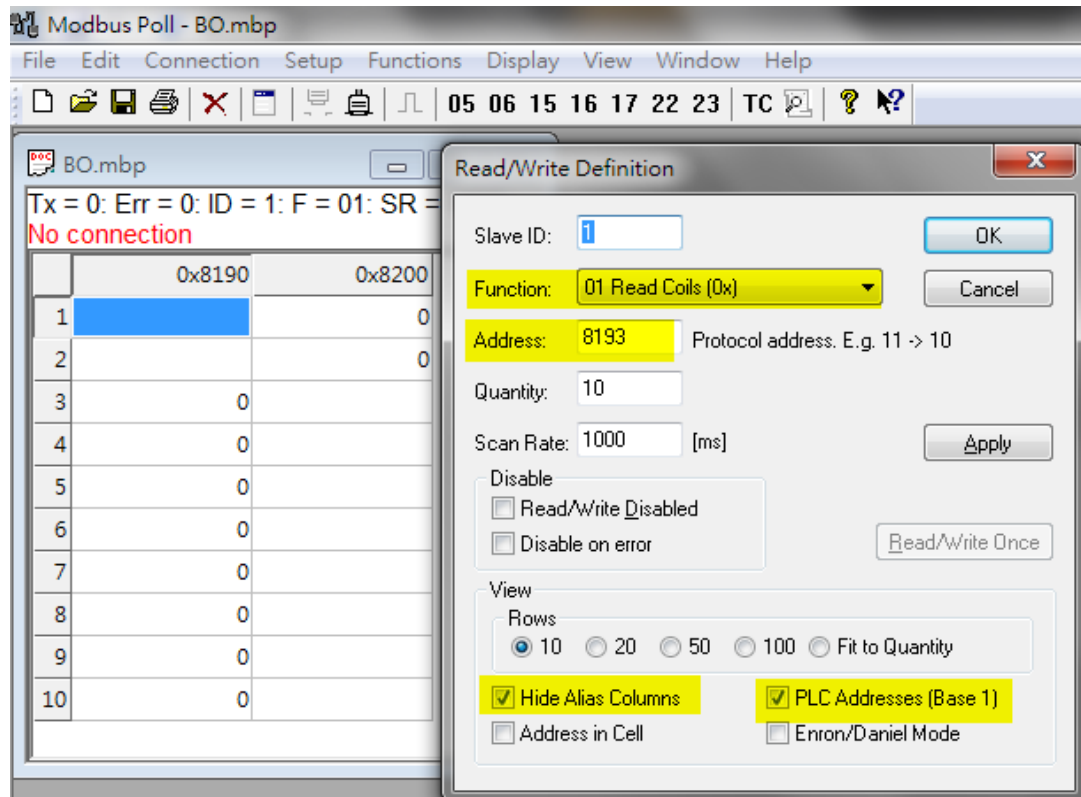
Your device :
DNP3 Serial Outstation

: mapped index : un-mapped index

Coil Address	Reg Address	Outstation	Index	Type
1x8193 - 1x8193	4x0513 - 4x0513			Value, 1 bit/point
--	4x19457 - 4x19457		BO [0]	Flag, 1 byte/point
1x8194 - 1x8194	4x0513 - 4x0513			Value, 1 bit/point
--	4x19457 - 4x19457		BO [1]	Flag, 1 byte/point
1x8195 - 1x8195	4x0513 - 4x0513			Value, 1 bit/point
--	4x19458 - 4x19458		BO [2]	Flag, 1 byte/point
1x8196 - 1x8196	4x0513 - 4x0513			Value, 1 bit/point
--	4x19458 - 4x19458		BO [3]	Flag, 1 byte/point
1x8197 - 1x8197	4x0513 - 4x0513			Value, 1 bit/point
--	4x19459 - 4x19459		BO [4]	Flag, 1 byte/point

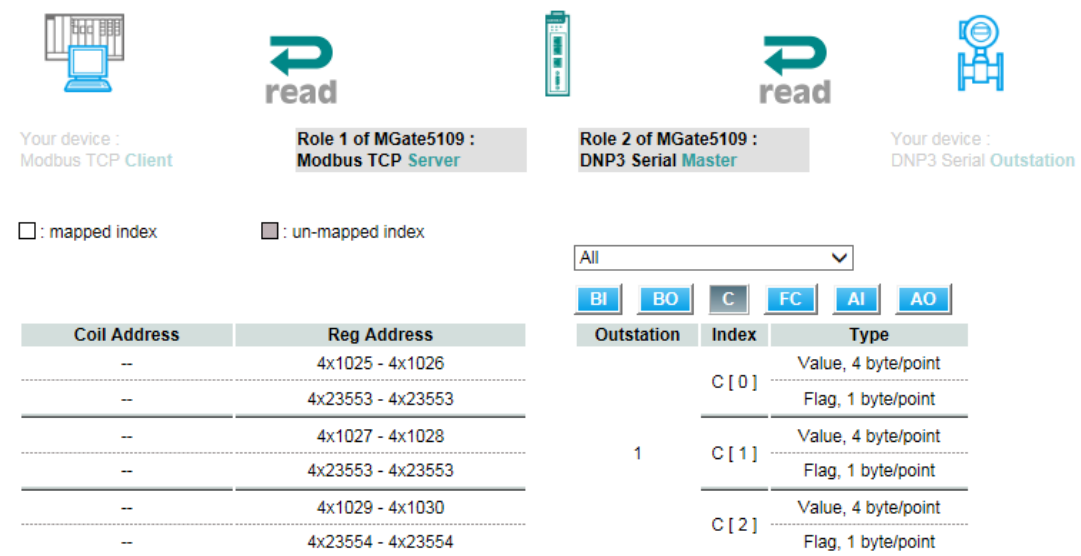
1

BO Status Command Definition:



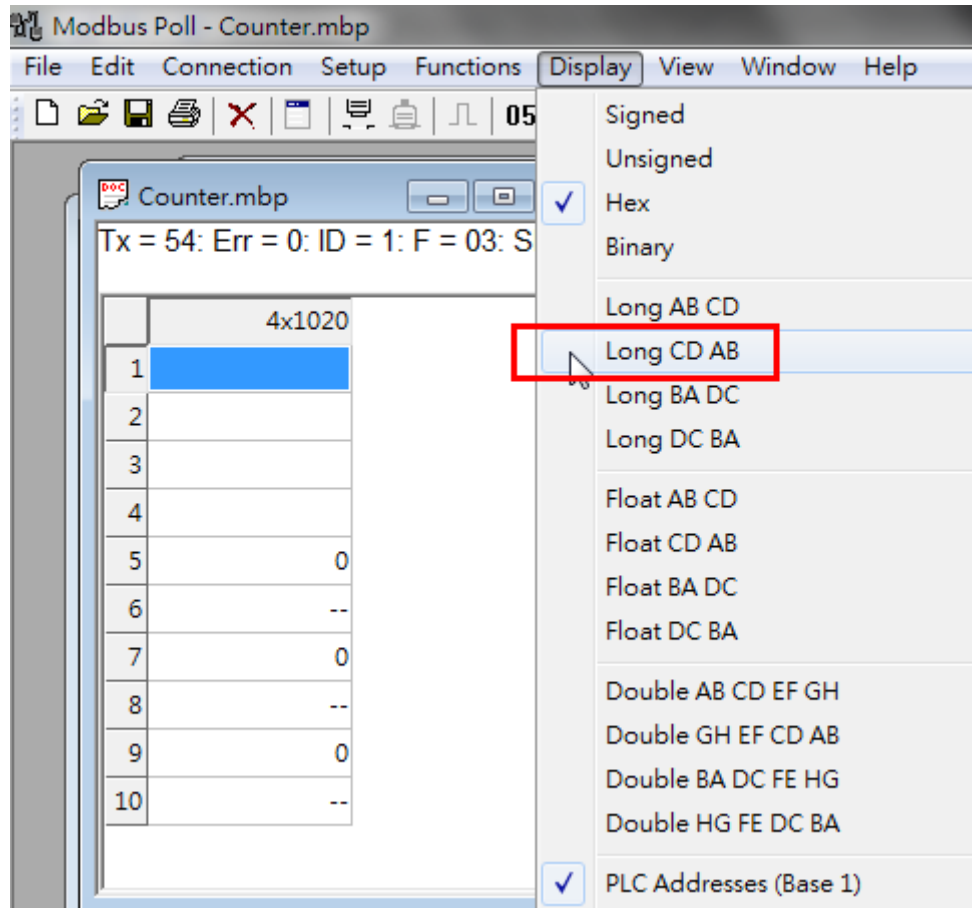
5.3. Read Counter Status Definition

Counter I/O Data Mapping:



Change **Display** to **Long CD AB** (i.e.,**Word Swap**).

Counter Status Command Definition:



5.4. Read AI Status Definition

AI I/O Data Mapping:

Your device : Modbus TCP Client Role 1 of MGate5109 : Modbus TCP Server Role 2 of MGate5109 : DNP3 Serial Master Your device : DNP3 Serial Outstation

: mapped index : un-mapped index

Coil Address	Reg Address
--	4x9217 - 4x9218
--	4x25601 - 4x25601
--	4x9219 - 4x9220
--	4x25601 - 4x25601
--	4x9221 - 4x9222
--	4x25602 - 4x25602
--	4x9223 - 4x9224
--	4x25602 - 4x25602

Outstation	Index	Type
	AI [0]	Value, 4 byte/point Flag, 1 byte/point
	AI [1]	Value, 4 byte/point Flag, 1 byte/point
	AI [2]	Value, 4 byte/point Flag, 1 byte/point
	AI [3]	Value, 4 byte/point Flag, 1 byte/point

Change **Display** to **Long CD AB** (i.e, **Word Swap**).

AI Status Command Definition:

Modbus Poll - AI.mbp

Tx = 0: Err = 0: ID = 1: F = 03: SR = 1000ms
No connection

	4x9210	4x9220	4x9230
1		0	0
2		--	--
3		0	
4		--	
5		0	
6		--	
7	0	0	
8	--	--	
9	0	0	
10	--	--	

Read/Write Definition

Slave ID: 1 OK

Function: 03 Read Holding Registers (4x) Cancel

Address: 9217 Protocol address. E.g. 40011 -> 10

Quantity: 16

Scan Rate: 1000 [ms] Apply

Disable

Read/Write Disabled

Disable on error Read/Write Once

View

Rows

10 20 50 100 Fit to Quantity

Hide Alias Columns PLC Addresses (Base 1)

Address in Cell Enron/Daniel Mode

5.5. Read AO Definition

AO I/O Data Mapping:

Your device : Modbus TCP Client

Role 1 of MGate5109 : Modbus TCP Server

Role 2 of MGate5109 : DNP3 Serial Master

Your device : DNP3 Serial Outstation

: mapped index : un-mapped index

Coil Address	Reg Address
--	4x13313 - 4x13313
--	4x26625 - 4x26625
--	4x13314 - 4x13314
--	4x26625 - 4x26625

Outstation	Index	Type
1		Value, 2 byte/point
	AO [0]	Flag, 1 byte/point
		Value, 2 byte/point
	AO [1]	Flag, 1 byte/point

Change **Display** to **Signed**.

AO Status Command Definition:

Modbus Poll - [AO.mbp]

File Edit Connection Setup Functions **Display** View Window Help

Tx = 0: Err = 0: ID = 1: F = 03: SR = 1000m

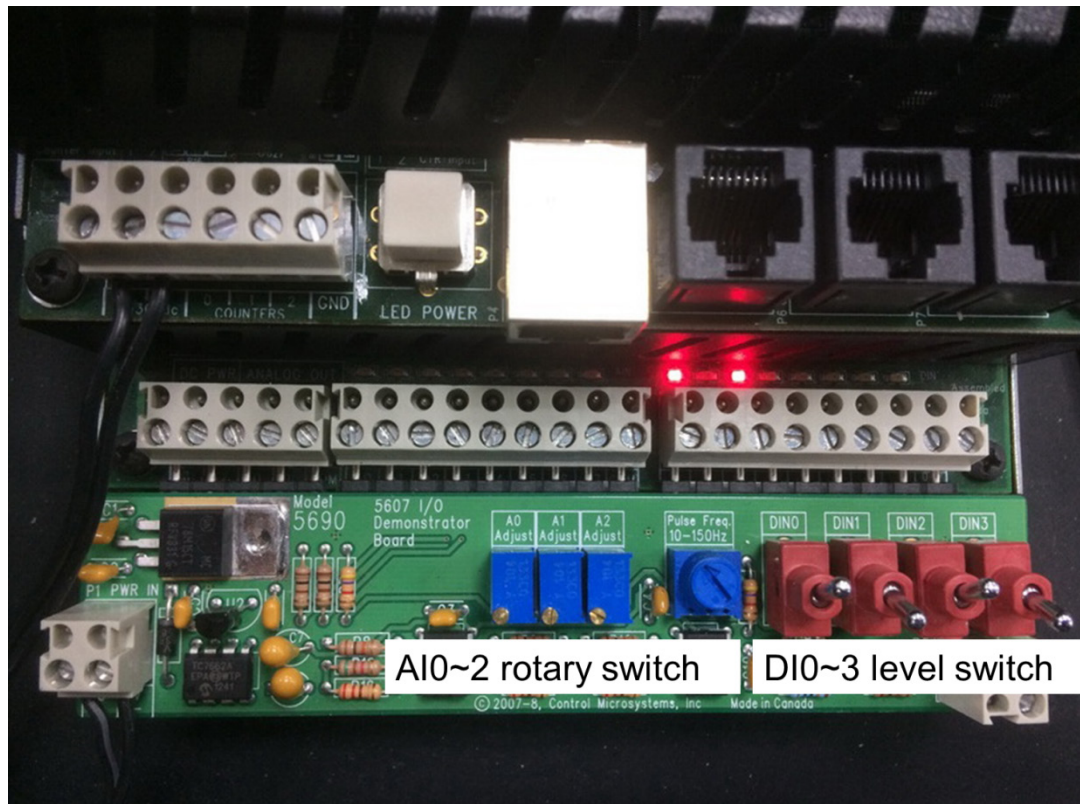
No connection

	4x13310
1	
2	
3	0
4	0
5	

6. Communication Test

6.1. 5607 I/O Demonstrator board Introduction

We can use the 5607 I/O Demonstrator board to control DI0-3 and AI0-2 status as follows:



6.2. MGate Protocol Diagnose Introduction

In the MGate 5109 web console, there is **Protocol Status** to diagnose the protocol status. It includes **I/O Data View**, **DNP3 Serial Diagnose**, and **DNP3 Serial Traffic** as follows:

Name	DNP3 Address	Msg Tx	Msg Rx	Last Msg Tx
SCADAPack334E	4	1531	1531	2017-01-05

In the **I/O Data View** web page, we can choose **Data flow direction** to see IO raw data in **Modbus TCP Client → DNP3 Serial Outstation** or **DNP3 Serial Outstation → Modbus TCP Client**.

⚙️ I/O Data View

Internal Address	00	01	02	03	04	05	06	07	08
0000h	00	00	00	00	00	00	00	00	00
0010h	00	00	00	00	00	00	00	00	00
0020h	00	00	00	00	00	00	00	00	00
0030h	00	00	00	00	00	00	00	00	00
0040h	00	00	00	00	00	00	00	00	00
0050h	00	00	00	00	00	00	00	00	00
0060h	00	00	00	00	00	00	00	00	00
0070h	00	00	00	00	00	00	00	00	00

In the **DNP3 Serial Traffic** web page, the MGate 5109 supports DNP3 Serial Traffic monitoring. Users can capture DNP3 Serial traffic and then export it as a text file for later analysis.

DNP3 Serial Traffic

Auto scroll

Start Stop **Export** Ready to capture.

No.	Time	Send/Receive	Data
3	2.787	Send	05 64 0B C4 04 00 03 00 E4 2B C6 CE 01 28 00 06 2C BF
4	2.814	Receive	05 64 17 44 03 00 04 00 E8 B4 D5 CE 81 00 00 28 02 01 00 00 01 00 01 00 00 01 F5 C7 00 00 FF FF
5	2.837	Send	05 64 0B C4 04 00 03 00 E4 2B C7 CF 01 14 00 06 9F B4
6	2.858	Receive	05 64 20 44 03 00 04 00 95 E3 D6 CF 81 00 00 14 01 01 00 00 02 00 01 00 00 00 4B 52 00 01 00 00 00 01 00 00 00
7	4.087	Send	05 64 0B C4 04 00 03 00 E4 2B C8 C0 01 1E 00 06 96 B2
8	4.112	Receive	05 64 39 44 03 00 04 00 6F B4 D7 C0 81 00 00 1E 01 01 00 00 07 00 01 5C 7A 00 B5 9C 00 01 B7 02 00 00 01 AA 31 00 00 01 01 00 00 00 81 A9 01 00
9	4.113	Receive	00 00 00 01 00 00 00 00 01 00 00 00 00 01 44 27 00 00 00 00 FF FF
10	7.788	Send	05 64 0B C4 04 00 03 00 E4 2B C9 C1 01 0A 00 06 6E 94
11	7.822	Receive	05 64 1B 44 03 00 04 00 5A 63 D8 C1 81 00 00 0A 02 01 00 00 09 00 01 01 01 01 DC A9 01 01 01 01 01 01 5E 2F
12	7.837	Send	05 64 0B C4 04 00 03 00 E4 2B CA C2 01 28 00 06 CF B1
13	7.867	Receive	05 64 17 44 03 00 04 00 E8 B4 D9 C2 81 00 00 28 02 01 00 00 01 00 01 00 00 01 7C 18 00 00 FF FF
14	7.877	Send	05 64 0B C4 04 00 03 00 E4 2B CB C3 01 14 00 06 7C BA
15	7.907	Receive	05 64 20 44 03 00 04 00 95 E3 DA C3 81 00 00 14 01 01 00 00 02 00 01 00 00 00 C2 8D 00 01 00 00 00 01 00 00 00

In the **DNP3 Serial Diagnose** web page, users can monitor the status of all DNP3 outstations, including the status of its Data Object Points.

DNP3 Serial Master Diagnose

Auto refresh Refresh

Select connected device Outstation address 4

Device Details

Status	Connected
Internal Indications	0x0000
Received Binary Input Event Count	0
Received Counter Event Count	0
Received Analog Input Event Count	0

Point Information

Binary Input

Point Index	Value	Flags	Time Updated
0	ON	OFFLINE	2017-01-05 11:05:03
1	OFF	N/A	2017-01-05 11:05:03
2	ON	N/A	2017-01-05 11:05:03
3	OFF	N/A	2017-01-05 11:05:03

6.3. DNP3 Connection Status

Check **System Monitoring** → **Protocol Status** → **DNP3 Serial Master Diagnose** and make sure **Outstation Address 4** is connected.

⚙️ DNP3 Serial Master Diagnose

Auto refresh

Select connected device

Device Details

Status	Connected
Internal Indications	0x0000
Received Binary Input Event Count	1
Received Counter Event Count	0
Received Analog Input Event Count	0

6.4. BI Test

Push DIN0, DIN2 level switch as **On** and DIN1, DIN3 level switch as **Off**. The SCADAPack 334 E will send an **Unsolicited Message** to notify that BI 0 and BI 2 have been updated to **On**. Check the status of Binary Input as follows:

MGate DNP3 Diagnose:

Point Information

Point Index	Value	Flags	Time Updated
0	ON	ONLINE	2016-12-28 15:59:19
1	OFF	ONLINE	2016-12-28 15:59:19
2	ON	ONLINE	2016-12-28 15:59:19
3	OFF	ONLINE	2016-12-28 15:59:19

SCADAPack E Configurator Point Browser:

Point Browser

Perform Automatic Read
Every Seconds

<F9> = Next Point

Type	Point #	Decimal	Hex	Description
	0	1	1	BI0
	1	0	0	BI1
	2	1	1	BI2
	3	0	0	BI3
	0	0	0	BO0
	0	8985	2319	AI0
	1	6723	1A43	AI1
	2	6326	18B6	AI2
	0	0	0	AO0
	0	0	0	CO0

Modbus Poll-BI status:

	0x0000	0x0010
1	1	0
2	0	0
3	1	0
4	0	0
5	0	0
6	0	0
7	0	
8	0	
9	0	
10	0	

MGate IO Dataview:

I/O Data View

Auto refresh

Data flow direction: Modbus TCP Client <-- DNP3 Serial Outstation

Start address(Hex): 0

Internal Address	00	01	02	03	04	05	06	07
0000h	05	00	00	00	00	00	00	00
0010h	00	00	00	00	00	00	00	00
0020h	00	00	00	00	00	00	00	00

BI 7 6 5 4 3 2 1 0
0 0 0 0 0 1 0 1

6.5. AI Test

Rotate the **AI0-2** rotary switch. If AI0- AI2 is changed to beyond the 10% deviation, the SCADAPack 334 E will send an **Unsolicited Message** with notifications of AI events. After the MGate 5109 polls AI actively, check the status of the **Analog Input** as follows:

MGate DNP3 Diagnose:

Point Information

Analog Input ▾

Point Index	Value	Flags	Time Updated
0	31324	ONLINE	2017-01-04 19:29:28
1	695	ONLINE	2017-01-04 19:29:28
2	12714	ONLINE	2017-01-04 19:29:28
3	1	ONLINE	2017-01-04 19:29:28
4	0	ONLINE	2017-01-04 19:29:28
5	0	ONLINE	2017-01-04 19:29:28
6	0	ONLINE	2017-01-04 19:29:28
7	0	ONLINE	2017-01-04 19:29:28

SCADAPack E Configurator Point Browser:

Point Browser

Write Write All Read Perform Automatic Read
Every 1 Seconds

<F9> = Next Point

Type	Point #	Decimal	Hex	Description
	0	1	1	BI0
	1	0	0	BI1
	2	1	1	BI2
	3	0	0	BI3
	4	0	0	
	0	31326	7A5E	AI0
	1	695	2B7	AI1
	2	12714	31AA	AI2
	0	0	0	A00
	1	0	0	
	0	0	0	BO0
	1	0	0	BO1
	2	0	0	BO2
	3	0	0	BO3

Modbus Poll-AI Status:

Modbus Poll - AI.mbp

File Edit Connection Setup Functions Display View Win Help

05 06 15 16 17 22

AI.mbp

Tx = 5: Err = 0: ID = 1: F = 03: SR = 1000ms

	4x9210	4x9220	4x9230
1		12712	0
2		--	--
3		1	
4		--	
5		0	
6		--	
7	31326	0	
8	--	--	
9	695	0	
10	--	--	

MGate IO Dataview:

I/O Data View

Auto refresh

Data flow direction: Modbus TCP Client <-- DNP3 Serial Outstation

AI 0

AI 1

Start address(Hex): 4800

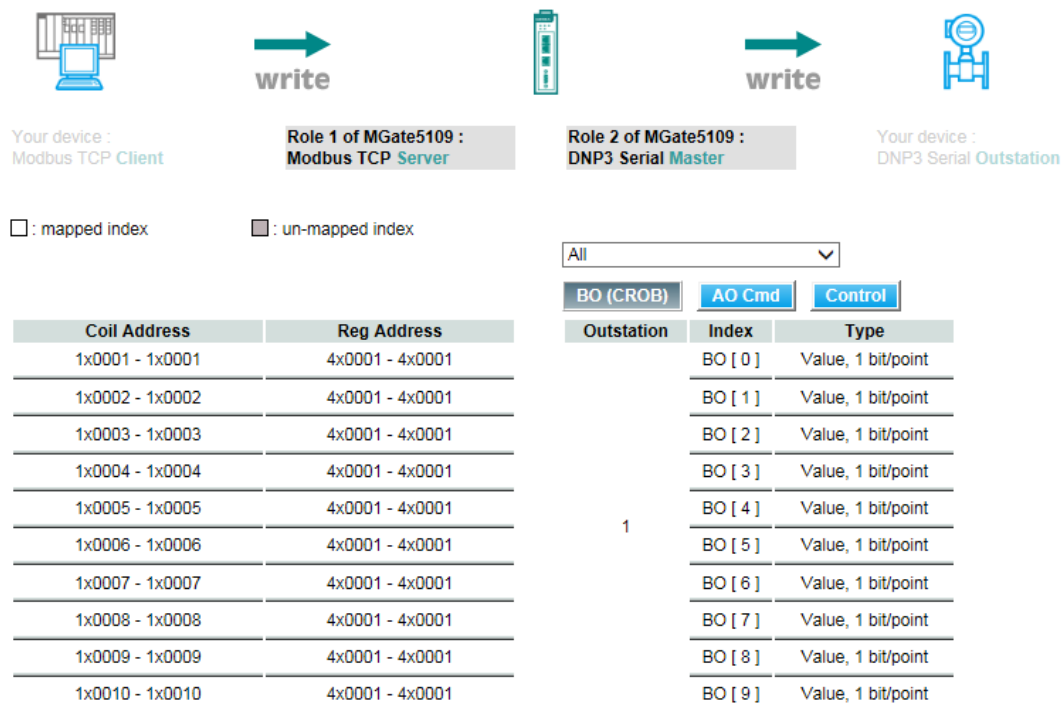
AI 2

Length: 128

Internal Address	00	01	02	03	04	05	06	07	08	09	0A	0B
4800h	7A	5E	00	00	02	B7	00	00	31	AA	00	00
4810h	00	00	00	00	00	00	00	00	00	00	00	00
4820h	00	00	00	00	00	00	00	00	00	00	00	00
4830h	00	00	00	00	00	00	00	00	00	00	00	00

6.6. BO Test

CROB command I/O Data Mapping:



CROB Parameter Setting:

Default CROB parameters

Index	Function code	Control models	Object count	On time (ms)	Off time (ms)
0	3/4: Select-Operate	Latch on-off model			
1	3/4: Select-Operate	Close-trip model	3	5000	5000
2	3/4: Select-Operate	Activation model	3	5000	5000

- Control Model - **Latch on-off model** test:
 Use Modbus **Function Code 5** to Write **Coil 1 (BO 0)** as **On**; the MGate 5109 will send **BO 0** as **Latch On** and the SCADAPack 334 E **BO0** will show as **On**. Write **Coil 1** as **Off**. The MGate 5109 will send **BO 0** as **Latch Off** and the SCADAPack 334 E **BO0** will show as **Off**.

- Control Model - **Close-trip model** test:

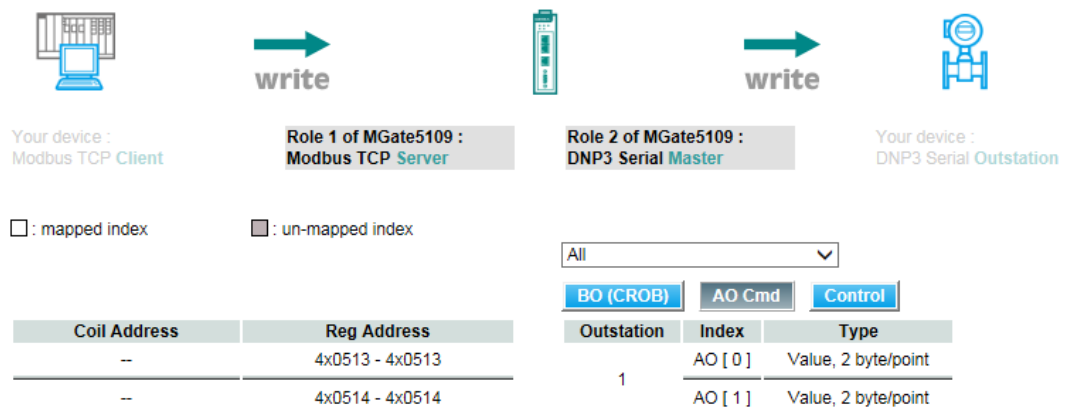
Use Modbus **Function Code 5** to Write **Coil 2 (BO 1)** as **On**, and the MGate 5109 will send **BO 1** as **Pulse ON with Close**. The SCADAPack 334 E **BO 1** will then show **On** for 5000 ms and then **Off** for 5000 ms, repeated three times. Then the status of **BO 1** stays **Off**. Write **Coil 2** as **Off**, and the MGate 5109 will send **BO 1** as **Pulse ON with Trip**, then SCADAPack 334 E **BO 1** will show **On** for 5000 ms and **Off** for 5000 ms, repeated three times. Then the status of **BO 1** stays **Off**.

- Control Model - **Activation model** test:

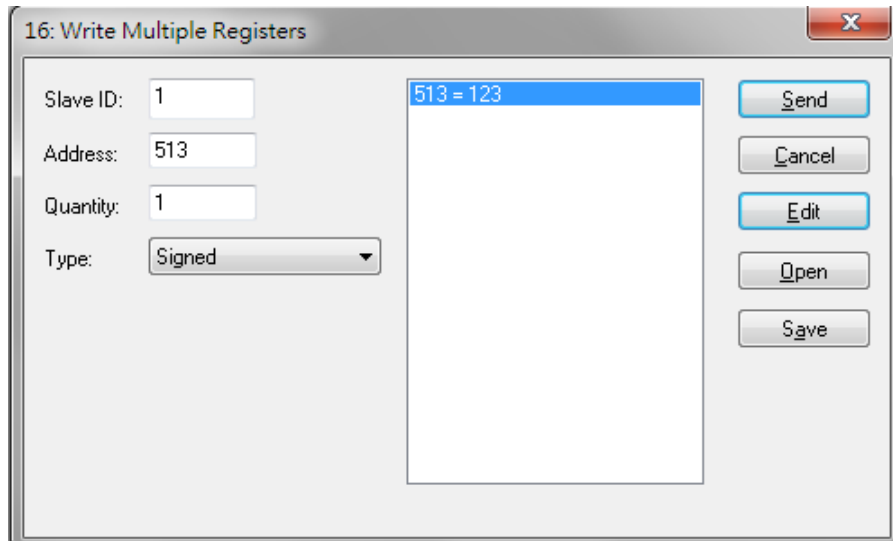
Use Modbus **Function Code 5** to Write **Coil 3 (BO 2)** as **On**, and the MGate 5109 will send **BO 2** as **Pulse ON**. The SCADAPack 334 E **BO 2** will then show **On** for 5000 ms and **Off** for 5000 ms, repeated for three times. The status of **BO 2** stays **Off**. Write **Coil 3** as **On** (In **Activation Model**, this BO internal address will be updated as **Off** when the CROB command is sent. So we just write this coil as **On** to trigger the CROB command.).The MGate 5109 will then send **BO 2** as **Pulse ON** and the SCADAPack 334 E **BO 2** will then show **On** for 5000ms and **Off** for 5000ms, repeated three times. The status of **BO 2** stays **Off**.

6.7. AO Test

AO command I/O Data Mapping:



Use Modbus **Function Code 16** to Write AO 0 as **123**:



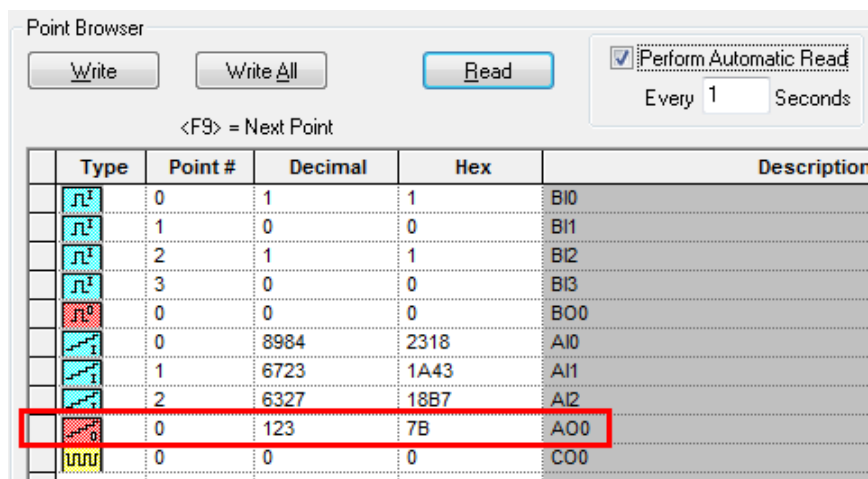
MGate DNP3 Diagnose:

Point Information

Analog Output ▾

Point Index	Value	Flags	Time Updated
0	123	ONLINE	2016-12-28 16:15:05
1	0	ONLINE	2016-12-28 16:15:05

SCADAPack E Configurator Point Browser:



MGate IO Dataview:**I/O Data View**

Auto refresh

Data flow direction: Modbus TCP Client <-- DNP3 Serial Outstation

Start address(Hex): 6800

Internal Address	00	01	02	03	04	05	06	07	08
6800h	00	7B	00	00	00	00	00	00	00
6810h	00	00	00	00	00	00	00	00	00
6820h	00	00	00	00	00	00	00	00	00
6830h	00	00	00	00	00	00	00	00	00
6840h	00	00	00	00	00	00	00	00	00
6850h	00	00	00	00	00	00	00	00	00
6860h	00	00	00	00	00	00	00	00	00
6870h	00	00	00	00	00	00	00	00	00

AO 0

7. Get Flag and Timestamp Test

DNP3 data objects not only contain the status of each value; some of them have quality indicators (flags) or timestamps.

There are several ways to update the data's values, flags and timestamps. Some scenarios are as follows:

- 1) The DNP3 Master sends a "Read Class 0 data" command. The outstation may respond to all static objects using each object's default variation setting, including "with/without flag" and "with/without time".
- 2) The DNP3 Master sends a "Read Specific data object" command. The outstation may respond to this object using its default variation setting, including "with/without flag" and "with/without time".
- 3) The DNP3 Master sends a "Read Class 1, 2, 3 data" command. The outstation may respond to all events using each object's default variation setting, including "with/without flag" and "with/without time".
- 4) The DNP3 Master sends a "Read specific event" command. The outstation may respond to all events using each object's default variation setting, including "with/without flag" and "with/without time". In DNP3 Level 2, the DNP3 Master can send "Read BI event" with "Absolute Time/ Relative Time" or without a timestamp.
- 5) The DNP3 Outstation can send an **Unsolicited Response** to the Master notifying about events "with/without flag" and "with/without time".

So in the MGate 5109’s DNP3 Diagnose, you should distinguish which flag or time is coming from which rules. When an outstation’s response is received, the **Value** of the **Points** will be updated with the latest value (the same point’s may include several events). **Flags** may be updated if response include flags. **Time Updated** will use the time the update was received.

MGate DNP3 Diagnose:

⌘ **DNP3 Serial Master Diagnose**

Auto refresh

Select connected device

Device Details	
Status	Connected
Internal Indications	0x0010
Received Binary Input Event Count	2
Received Counter Event Count	0
Received Analog Input Event Count	0

Point Information			
Binary Input <input type="text" value=""/>			
Point Index	Value	Flags	Time Updated
0	OFF	ONLINE	2017-01-06 14:22:17
1	ON	ONLINE	2017-01-06 14:22:17
2	ON	ONLINE	2017-01-06 14:22:18
3	ON	ONLINE	2017-01-06 14:22:18

In the following figure, we illustrate how to get the MGate 5109 BI object’s flags or timestamps via opposite protocol-Modbus TCP.

Complete I/O Data Mapping as follows:

⌘ DNP3 Serial Master Diagnose

Auto refresh

Select connected device

Device Details

Status	Connected
Internal Indications	0x0010
Received Binary Input Event Count	2
Received Counter Event Count	0
Received Analog Input Event Count	0

Point Information

Binary Input

Point Index	Value	Flags	Time Updated
0	OFF	ONLINE	2017-01-06 14:22:17
1	ON	ONLINE	2017-01-06 14:22:17
2	ON	ONLINE	2017-01-06 14:22:18
3	ON	ONLINE	2017-01-06 14:22:18

Read BI 0-3’s **Flag** as follows. Each BI point has one byte. The bit 0 “Set” indicates flag as ONLINE.

Modbus Master Read BI’s Flag:

	Alias	4x15360
1	BI0, 1	0000 0001 0000 0001
2	BI2, 3	0000 0001 0000 0001
3	BI4, 5	0000 0000 0000 0000

Read BI 0-3's **Update Time** as follows. Each BI point has 6 bytes. These 6 bytes are "milliseconds since the start of January 1, 1970 UTC".

Modbus Master Read BI's Updated Time:

	Alias	4x27640	Alias	4x27650
1			BI 0 Register 3	0x0159
2			BI 1 Register 1	0x6680
3			BI 1 Register 2	0x9852
4			BI 1 Register 3	0x0159
5			BI 2 Register 1	0x697C
6			BI 2 Register 2	0x9852
7			BI 2 Register 3	0x0159
8			BI 3 Register 1	0x6B85
9	BI 0 Register 1	0x64C8	BI 3 Register 2	0x9852
10	BI 0 Register 2	0x9852	BI 3 Register 3	0x0159

MGate DNP3 Diagnose –BI Status:

Point Information

Binary Input

Point Index	Value	Flags	Time Updated
0	OFF	ONLINE	2017-01-06 14:56:11
1	ON	ONLINE	2017-01-06 14:56:11
2	ON	ONLINE	2017-01-06 14:56:12
3	ON	ONLINE	2017-01-06 14:56:12