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Process Bus IEC 61850 Simulation & Test

SIPROTEC 5 Application

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Process Bus IEC 61850 Simulation & Test

APN-087, Edition 2

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Process Bus IEC 61850 Simulation & Test

APN-087, Edition 1

1 Process Bus Simulation and Test

1.1 Introduction

As the implementation of the process bus technology gains importance in the electrical system and displaces the conventional technology, a major topic for most of the users is: how such a system can be properly tested? Especially, when it is already in operation and the same merging unit publishes sampled values for several protection devices. In this case, the simulation and test modes described in the IEC 61850 standard are very helpful. In the first part of this application note we will focus attention on the simulation mode and in the second part on the test mode.

1.2 Operation Modes in SIPROTEC 5

Before we start understanding the simulation and test modes described in the IEC 61850 standard, it is important to provide clarification on the operational modes offered in the SIPROTEC 5 family. The SIPROTEC 5 devices have the following operating modes available:

- Commissioning mode → The commissioning mode of the SIPROTEC 5 device allows to check the existing wiring without affecting or blocking the protection functions or other functions of the device, to check the communication with system-control technology.
- Simulation mode → In the simulation mode, the SIPROTEC 5 device behaves as in the process mode. the correct setting of protection functions and the routing of signals can be checked. The device can be tested without wiring and without external test equipment. In addition, it is possible to utilize test sequences for the test generator integrated in the SIPROTEC 5 device.
- Process mode → The process mode is the normal operation of the device and all functions are available

Please note that the "Simulation Mode" described above differs fundamentally from the simulation mode described in the IEC 61850 Standard, which is the object in this application note.

1.3 Simulation Mode according to the IEC 61850

The Edition 2 introduced a new identifier to distinguish between real and simulated messages, which covers both GOOSE and SV communications. Inside the Reserved 1 section of the ISO/IEC/IEEE 8802-3 frame format appears now the S bit, referred also as Sim bit.

The S bit must be set when GOOSE or SV are published by a test device and not by the publisher specified in the configuration file of the device. This means, that messages with simulation bit set to TRUE can only be published by test systems.

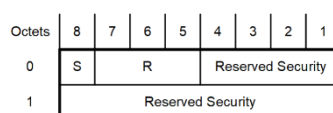


Figure 1. Reserved 1 section

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On the other side, the subscriber or receiving device must be able to understand and properly handle signals coming either from the process (actual devices) or from a testing device. The receiving device must know when either one or the other type of information is required. For that, the simulation mode is used. The simulation mode shall be set by the user with help of the control signal `Sim` included in the physical device node `LPHD` (`LPHD.Sim.Oper.ctlVal`). The mode is applied to the entire physical device, emulating to some extent the use of the traditional test switches. The current status can be read from the `LPHD.Sim.stVal` signal.

Setting the device into Simulation Mode and the injection of the simulated signals don't need to happen simultaneously. Simulated signals will be ignored if the device is in normal operation mode (`LPHD.Sim.stVal = FALSE`). Process signals will be accepted by a device in simulation mode (`LPHD.Sim.stVal = TRUE`) until the first simulated message for a given subscription is received. From that moment on the corresponding process message including the associated signals will be ignored and only the simulated message and associated signals accepted for the given subscription accepted. It happens on a telegram (SV stream or GOOSE message) basis. It means, if the IED subscribes to other non-simulated GOOSE messages and/or SV streams, it will continue to handle these other process subscriptions, as a device in simulation mode can process both simulated streams and actual streams simultaneously. Keep in mind that for a specific GOOSE or SV only either the simulated or the actual signal will be accepted. Each subscription is supervised by an LGOS respectively LSVS logical node instance. The `LGOS.SimSt.stVal` resp. `LSVS.SimSt.stVal` signals indicate if the supervised subscription is accepting simulated messages. `LGOS.St.stVal` resp. `LSVS.St.stVal` signals indicates if the supervised subscription is currently getting messages of the appropriate kind (process messages when `SimSt.stVal` is false, simulated messages when `SimSt.stVal` is true).

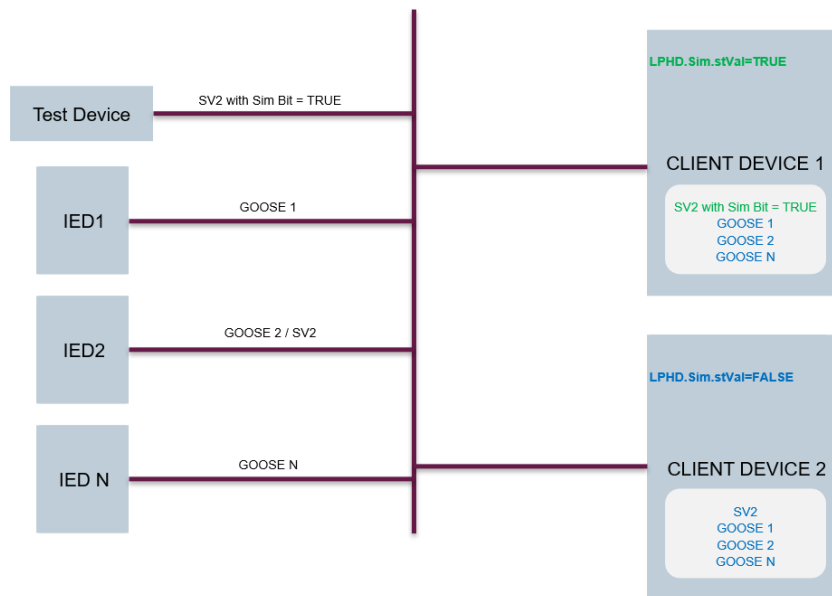


Figure 2. Acceptance of signals depending on Simulation Mode

1.3.1 Set of Simulation Mode in SIPROTEC 5 devices

As indicated before, the simulation mode can be set in a device by setting the `LPHD.Sim.Oper.ctlVal` (**Device: GOOSE/SV sim.mode**) to TRUE (1)

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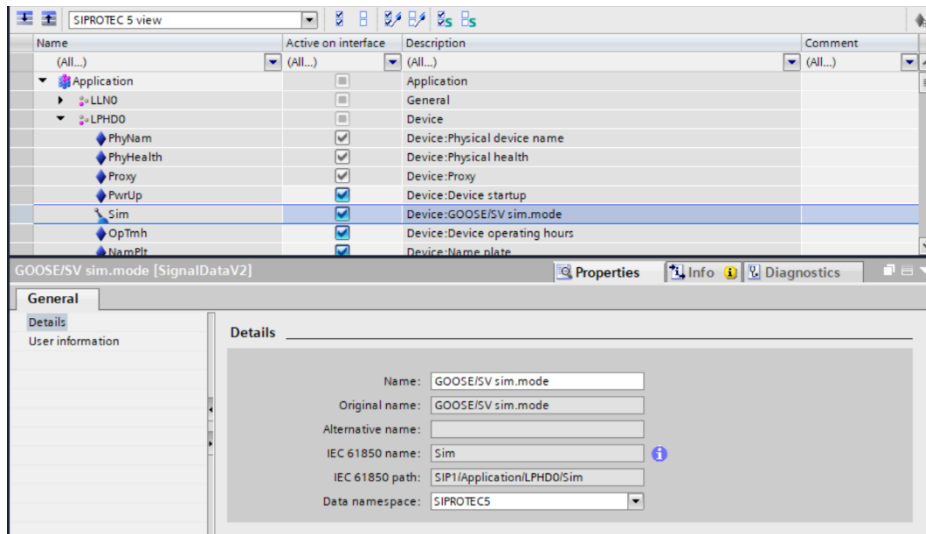


Figure 3. DIGSI 5 - IEC 61850 Simulation Signal

This can be done using the SIEMENS IEC-Browser. First make sure you **Enable Write** in the "Extras" Menu.

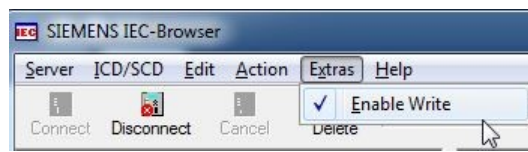


Figure 4. SIEMENS IEC-Browser: Enable Write

Then, go to the Application, select the physical device logical node LPHD and click-right on the "Sim" Control:

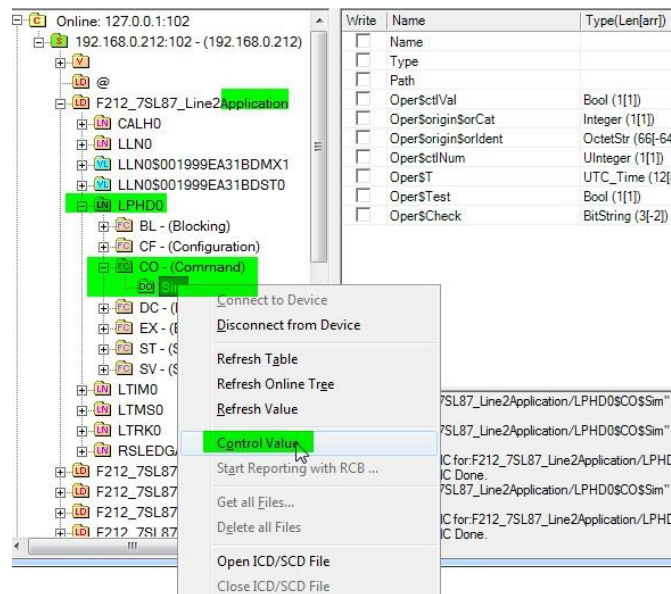


Figure 5. SIEMENS IEC-Browser: Simulation Signal

As soon as the control dialog appears, you can set the simulation mode by clicking on the **Close** button.

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Process Bus IEC 61850 Simulation & Test

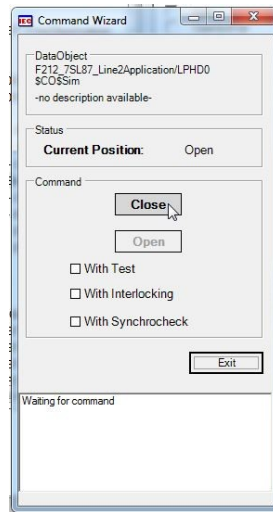


Figure 6. SIEMENS IEC-Browser: Simulation Signal Control

The Simulation mode can also be switched from a SICAM SCC interface via IEC61850-8-1 MMS

1.3.2 Verification of Simulation Mode in SIPROTEC 5 devices

The status of the Sim signal can be seen in the IEC Browser as well. If the simulation has not been activated, the value will appear as (false) 0 as shown below.

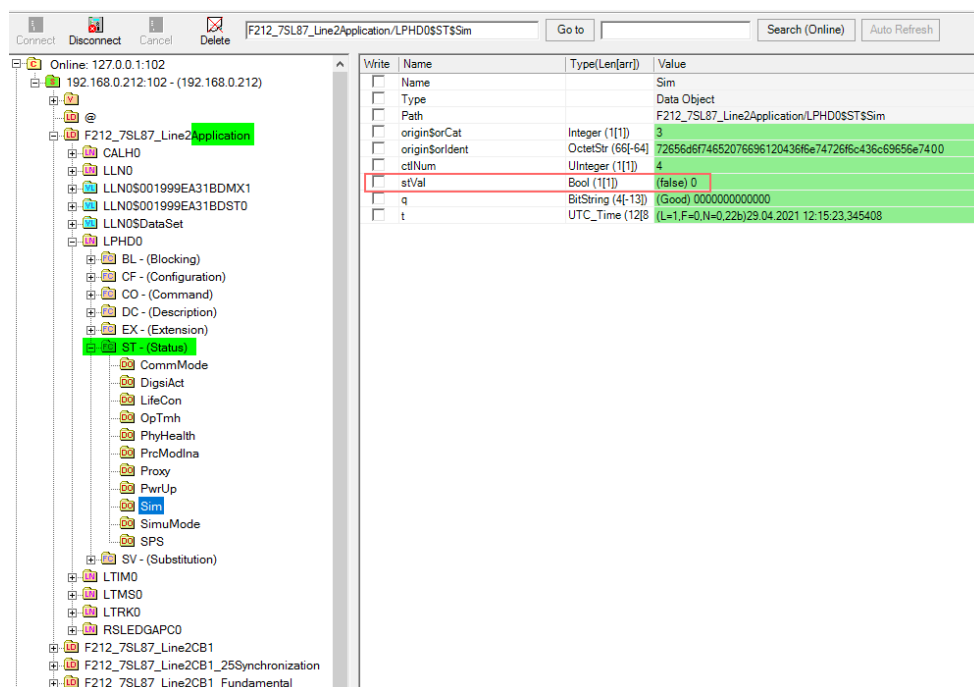


Figure 7. SIEMENS IEC-Browser: Simulation Signal Status Disabled

When the Simulation mode has been activated, the value appears as (true) 1

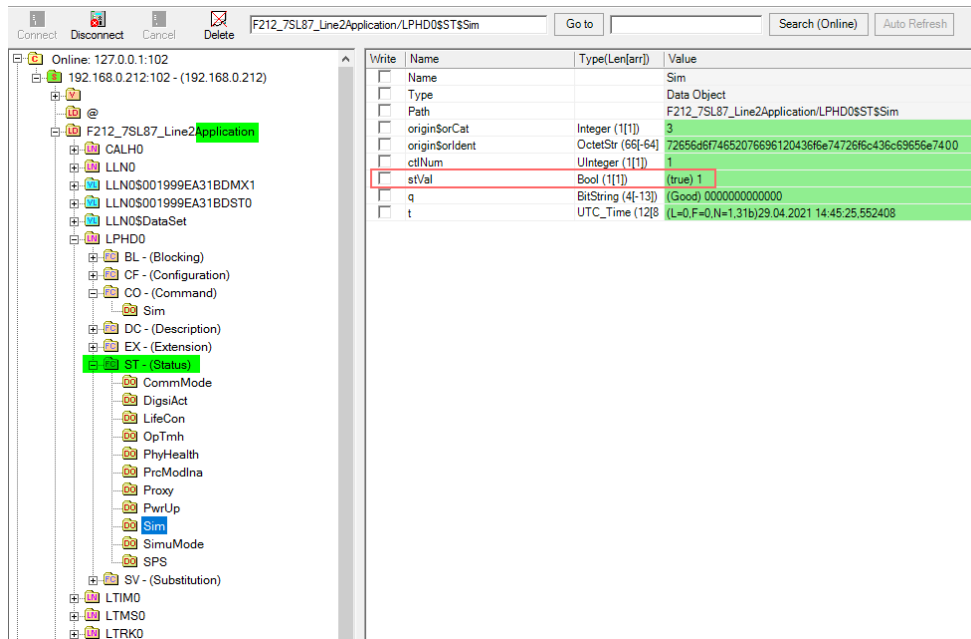


Figure 8. SIEMENS IEC-Browser: Simulation Signal Status Enabled

It is, however, desired by most of the customers to be able to see such a feedback in the protection device. Here are shown a couple of options.

a. Visualization in the event log



Figure 9. DIGSI 5 – IEC 61850 Simulation Status in Event Log

b. Visualization in an LED

The feedback information is contained in the **Device:GOOSE/SV sim.mode** signal and be assigned directly to a LED from the V8.40 but this signal cannot be directly assigned to an LED if using the V8.30 or earlier. In later case, a user defined signal SPS (in this example: "SimModeGOOSE/SV_Active") must be created and generated by a CFC using a SPLIT block.

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Process Bus IEC 61850 Simulation & Test

Information			Destination			
			LEDs			
			Base module			
Signals	Number	Type	1.1	1.2	1.3	1.4
(All)	(All)
▶ Cyber-security event	4171.322	ENS				
▶ Event lost	4171.323	SPS				
▶ GOOSE/SV sim.mode	4171.342	SPC				
▶ Simulation mode active	4171.317	SPS				
▶ Commiss. mode active	4171.318	SPS				
▶ Device operating hours	4171.326	INS				
▶ SimModeGOOSE/SV_Active		SPS				U

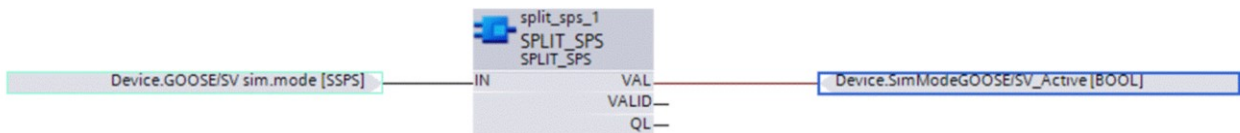


Figure 10. DIGSI 5 – IEC 61850 Simulation Status signal for LED

As a reminder, please do not confuse the SIPROTEC 5 Simulation Mode indication with the IEC 61850 Simulation Mode feedback.

So, when you see in DIGSI/Device the signal

▶ GOOSE/SV sim.mode	4171.342	SPC		
▶ Simulation mode active	4171.317	SPS		

Figure 11. SIPROTEC 5 Simulation Mode Signal

It refers to the Siemens internal Simulation Mode and not to the IEC 61850.

Now, the signal

▶ GOOSE/SV sim.mode	4171.342	SPC		
▶ Simulation mode active	4171.317	SPS		

Figure 12. IEC 61850 Simulation Mode Signal

is the controllable one defined by the IEC 61850 Standard.

1.3.3 Working with the Simulation Mode

During testing of systems in real operation, simulated and process signals will be present simultaneously in the network. Process signals will be recognized by the protection devices, as per the Reserved 1= 0x0000 (0) (see Figure 1.)

In the figure below (capture with wireshark), it can be seen a process stream coming from a MU with the destination MAC Address 01:0C:CD:04:00:02

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No.	Time	Source	Destination	Protocol	Length	Info
1	10:45:18.268582000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
2	10:45:18.268583000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
3	10:45:18.268583000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
4	10:45:18.268583000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
5	10:45:18.268584000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
6	10:45:18.268584000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
7	10:45:18.268584000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
8	10:45:18.268585000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
9	10:45:18.268585000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
10	10:45:18.268586000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
11	10:45:18.269059000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
12	10:45:18.269060000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
13	10:45:18.269060000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
14	10:45:18.269061000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
15	10:45:18.269061000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
16	10:45:18.269061000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
17	10:45:18.269062000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
18	10:45:18.269062000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
19	10:45:18.269062000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
20	10:45:18.269389000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
21	10:45:18.269389000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
22	10:45:18.269390000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
23	10:45:18.269390000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
24	10:45:18.269390000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
25	10:45:18.269391000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
26	10:45:18.269883000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
27	10:45:18.269887000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
28	10:45:18.269887000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	

```

Frame 13: 135 bytes on wire (1080 bits), 135 bytes captured (1080 bits) on interface 0
Ethernet II, Src: b4:b1:5a:0c:33:e3 (b4:b1:5a:0c:33:e3), Dst: Iec-Tc57_04:00:02 (01:0c:cd:04:00:02)
IEC61850 Sampled Values
  APPID: 0x4002
  Length: 121
  Reserved 1: 0x0000 (0)
  Reserved 2: 0x0000 (0)
  savPdu
    noASDU: 1
    seqASDU: 1 item
      ASDU
        sVID: SIP1Mod2MU103
        smpcnt: 1943
        confRef: 1
        smpsynch: global (2)
        PhsMeas1
          value: -1021
          quality: 0x00000000, validity: good, source: process
          value: -31
          quality: 0x00000000, validity: good, source: process
  
```

Figure 13. Stream coming from process device

A stream with the same destination MAC Address 01:0C:CD:04:00:02 but generated by a testing device can be seen below and recognized through the Reserved 1 field in 0x8000 (32768) (capture with wireshark):

No.	Time	Source	Destination	Protocol	Length	Info
1	10:45:18.268582000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
2	10:45:18.268583000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
3	10:45:18.268583000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
4	10:45:18.268583000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
5	10:45:18.268584000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
6	10:45:18.268584000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
7	10:45:18.268584000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
8	10:45:18.268585000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
9	10:45:18.268585000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
10	10:45:18.268586000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
11	10:45:18.269059000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
12	10:45:18.269060000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
13	10:45:18.269060000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
14	10:45:18.269061000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
15	10:45:18.269061000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
16	10:45:18.269061000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
17	10:45:18.269062000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
18	10:45:18.269062000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
19	10:45:18.269062000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
20	10:45:18.269389000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
21	10:45:18.269389000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	
22	10:45:18.269390000	b4:b1:5a:0c:34:3c	Iec-Tc57_04:00:03	IEC61850 Sampled Values	135	
23	10:45:18.269390000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
24	10:45:18.269390000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
25	10:45:18.269391000	OmicronE_06:28	Iec-Tc57_04:00:02	IEC61850 Sampled Values	125	
26	10:45:18.269883000	b4:b1:5a:0c:36:76	Iec-Tc57_04:00:00	IEC61850 Sampled Values	145	
27	10:45:18.269887000	b4:b1:5a:0c:33:e3	Iec-Tc57_04:00:02	IEC61850 Sampled Values	135	
28	10:45:18.269887000	b4:b1:5a:0c:36:5c	Iec-Tc57_04:00:04	IEC61850 Sampled Values	135	

```

Frame 15: 125 bytes on wire (1000 bits), 125 bytes captured (1000 bits) on interface 0
Ethernet II, Src: OmicronE_06:28 (00:50:c2:9b:b6:28), Dst: Iec-Tc57_04:00:02 (01:0c:cd:04:00:02)
IEC61850 Sampled Values
  APPID: 0x4002
  Length: 111
  Reserved 1: 0x8000 (32768)
  Reserved 2: 0x0000 (0)
  savPdu
    noASDU: 1
    seqASDU: 1 item
      ASDU
        sVID: SIP1Mod2MU103
        smpcnt: 1947
        confRef: 1
        smpsynch: global (2)
        PhsMeas1
          value: 247839
          quality: 0x00000000, validity: good, source: process
          value: -5919
          quality: 0x00000000, validity: good, source: process
  
```

Figure 14. Stream coming from a simulation device

With both telegrams present in the network, the acceptance of one or the other is defined by the Simulation Mode of the device.

If the Simulation Mode = true, the device will accept the simulated values. This can be seen in the `LSVS.SimSt = true`

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The screenshot shows the SIPROTEC 5 Client interface. The tree view on the left is expanded to show the hierarchy: RSLEDGAPC0 > F212_7SL87_Line2CB1 > F212_7SL87_Line2ComSupervision_SV > LSVS1 > SimSt. The 'SimSt' node is highlighted with a red box. The 'Write' table on the right displays the following data:

Write	Name	Type(Len[arr])	Value
<input type="checkbox"/>	Name		SimSt
<input type="checkbox"/>	Type		Data Object
<input type="checkbox"/>	Path		F212_7SL87_Line2ComSupervision_SV/LSVS1\$ST\$SimSt
<input checked="" type="checkbox"/>	stVal	Bool (1[1])	(true) 1
<input type="checkbox"/>	q	BitString (4[-13])	(Good) 0000000000000
<input type="checkbox"/>	t	UTC_Time (12[8])	(L=1,F=0,N=0,21b)29.04.2021 11:44:48.124408

Figure 15. Simulated signals received in Client device

When simulated signals are not being received or accepted the **LSVS.SimSt = false**

The screenshot shows the SIPROTEC 5 Client interface. The tree view on the left is expanded to show the hierarchy: RSLEDGAPC0 > F212_7SL87_Line2CB1 > F212_7SL87_Line2ComSupervision_SV > LSVS2 > SimSt. The 'SimSt' node is highlighted with a red box. The 'Write' table on the right displays the following data:

Write	Name	Type(Len[arr])	Value
<input type="checkbox"/>	Name		SimSt
<input type="checkbox"/>	Type		Data Object
<input type="checkbox"/>	Path		F212_7SL87_Line2ComSupervision_SV/LSVS2\$ST\$SimSt
<input checked="" type="checkbox"/>	stVal	Bool (1[1])	(false) 0
<input type="checkbox"/>	q	BitString (4[-13])	(Good) 0000000000000
<input type="checkbox"/>	t	UTC_Time (12[8])	(L=0,F=0,N=1,31b)28.04.2021 16:07:33.324000

Figure 16. Simulated signals not received in Client device

It is also possible to see in the communication supervision log whether simulated values are being processed in the device

Date	Time	Functions structure	Name	Value
29.04.2021	13:44:48.324	Com. supervision:SV supervision	Subscription 1:Diagnosis error	no error
29.04.2021	13:44:48.127	Com. supervision:SV supervision	Group Indic.:Group indication	on
29.04.2021	13:44:48.124	Com. supervision:SV supervision	Subscription 1:Diagnosis time sync.	Global synch.
29.04.2021	13:44:48.124	Com. supervision:SV supervision	Subscription 1:Diagnosis error	Data delay error
29.04.2021	13:44:48.124	Com. supervision:SV supervision	Subscription 1:Status Sim messages	on

Figure 17. Simulated signals received in Client device – COM Supervision Log

Simulated values will be shown in the protection device as follows:

Operational values	Fund./sym.comp.	Function values	Min/max/avg. val.	Energy	User-def. values
Measurements	Value	Quality	Number		
Operational values					
f	50.00 Hz	good (process/test)	21.761.10211.304		
Vph:A	63.51 kV	good (process/test)	21.761.10031.302		
Vph:B	63.51 kV	good (process/test)	21.761.10031.302		
Vph:C	63.51 kV	good (process/test)	21.761.10031.302		
Vpp:AB	110.00 kV	good (process/test)	21.761.10031.301		
Vpp:BC	110.00 kV	good (process/test)	21.761.10031.301		
Vpp:CA	110.00 kV	good (process/test)	21.761.10031.301		
Vph:res	0 kV	good (process/test)	21.761.10031.302		
VN	0 kV	good (process/test)	21.761.10031.305		
Iph:A	200 A	good (process/test)	21.761.10031.300		
Iph:B	200 A	good (process/test)	21.761.10031.300		
Iph:C	200 A	good (process/test)	21.761.10031.300		
Iph:res	0 A	good (process/test)	21.761.10031.300		
IN	0 A	good (process/test)	21.761.10031.303		
P tot	38.09 MW	good (process/test)	21.761.10211.300		
Q tot	-0.01 Mvar	good (process/test)	21.761.10211.301		
S tot	38.09 MVA	good (process/test)	21.761.10211.302		
cosφ	1.00	good (process/test)	21.761.10211.303		
P:A	12.695 MW	good (process/test)	21.761.10211.305		
P:B	12.694 MW	good (process/test)	21.761.10211.305		
P:C	12.697 MW	good (process/test)	21.761.10211.305		
Q:A	-0.002 Mvar	good (process/test)	21.761.10211.306		
Q:B	-0.003 Mvar	good (process/test)	21.761.10211.306		
Q:C	-0.001 Mvar	good (process/test)	21.761.10211.306		
S:A	12.695 MVA	good (process/test)	21.761.10211.307		
S:B	12.694 MVA	good (process/test)	21.761.10211.307		
S:C	12.697 MVA	good (process/test)	21.761.10211.307		

Figure 18. Simulated values in DIGSI 5 (process/test because the device is in test mode)

The Group indication in the SV supervision will be also set if at least one simulated signal is being accepted.

GOOSE messages can also be simulated in a similar way. In this case, the simulation flag can be seen in two different parts in the telegram:

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Process Bus IEC 61850 Simulation & Test

```
Frame 18483: 187 bytes on wire (1496 bits), 187 bytes captured  
Ethernet II, Src: OmicronE_06:28 (00:50:c2:9b:b6:28), Dst: Iec-  
GOOSE  
  APPID: 0x0001 (1)  
  Length: 173  
  Reserved 1: 0x8000 (32768)  
  Reserved 2: 0x0000 (0)  
  goosePdu  
    gocbRef: MU2GOApplication/LLN0$GO$Control_DataSet_1  
    timeAllowedToLive: 4000  
    dataSet: MU2GOApplication/LLN0$dataSet_1  
    goID: MU2GOApplication/LLN0/Control_DataSet_1  
    t: Aug 21, 2019 07:34:25.899968743 UTC  
    sENum: 1  
    sGNum: 13  
    test: True  
    confRev: 10001  
    ndscom: False  
    numDataSetEntries: 2  
  allData: 2 items  
  Data: boolean (3)  
    boolean: False  
  Data: bit-string (4)  
    padding: 3  
    bit-string: 0000
```

Figure 19. GOOSE Message coming from a simulation device

1.3.4 Simulating with injection kit

There are several simulation tools in the market as Omicron, Doble, Megger, among others. In this chapter, it will be explained the simulation with Omicron devices.

The Omicron device must be connected to the process bus. In this example we will use the ETH1 port. A PC with the Test Universe SW to control the CMC must be also available in the network.

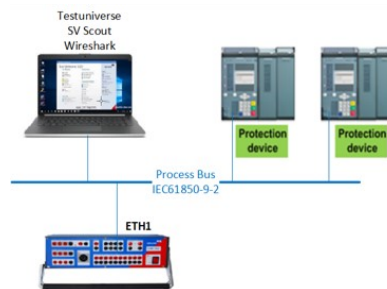


Figure 20. Omicron CMC connected to process bus

1.3.4.1 Omicron Test Universe 4.30

Prefer the latest version of the Test Universe, the 4.30 as flexible streams are supported additionally to the IEC61850-9-2LE streams

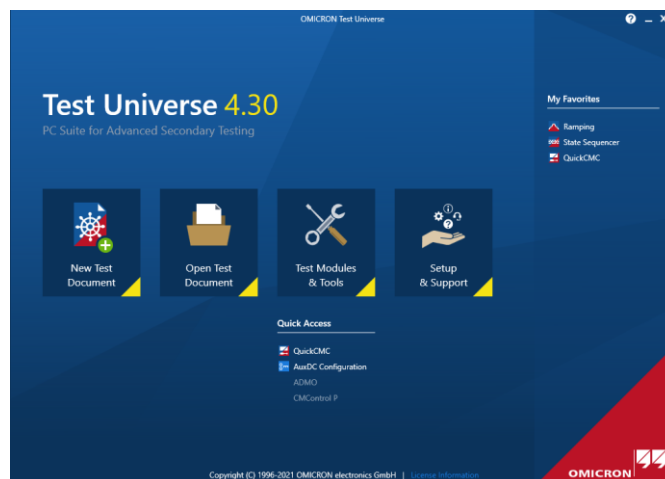


Figure 21. Omicron Test Universe 4.30

Select Test Modules & Tools

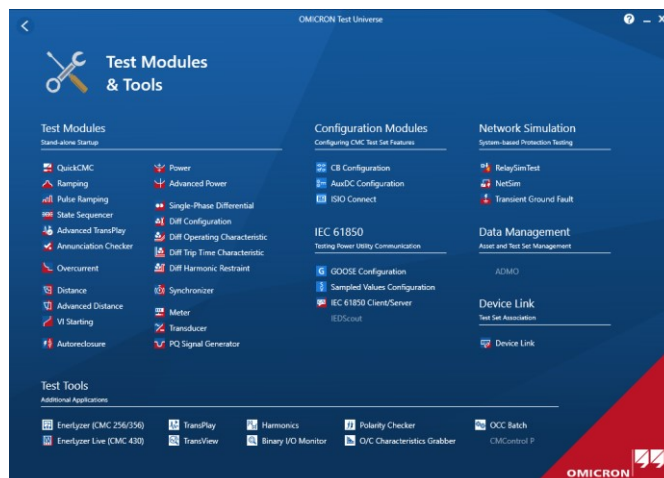


Figure 22. Test Modules & Tools

In previous version of Test Universe, SMV configuration is done using the Sample Values Configuration module. From this version, the sampled values configuration is to be done directly in a test module, e.g. State Sequencer, in the Hardware Configuration option,

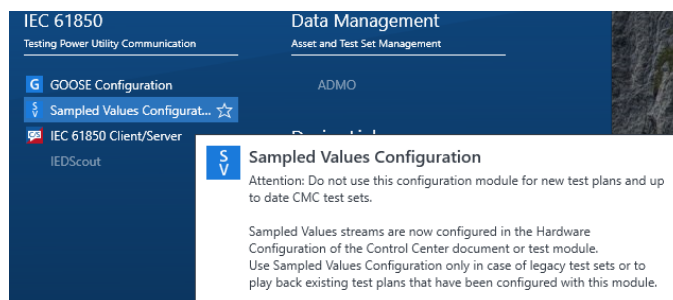


Figure 23. Sampled Values Configuration - Warning

Select a Test Module, the State Sequencer module for example and go to the Hardware configuration.

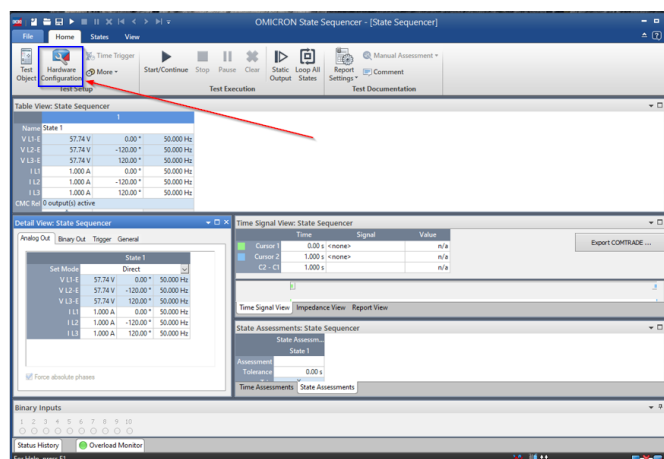


Figure 24. State Sequencer Module

In the Tab – General, define how many analog outputs and sampled value outputs will be used from test set. In the example, no analog output and 2 voltage systems + 2 current systems from sampled valued will be used.

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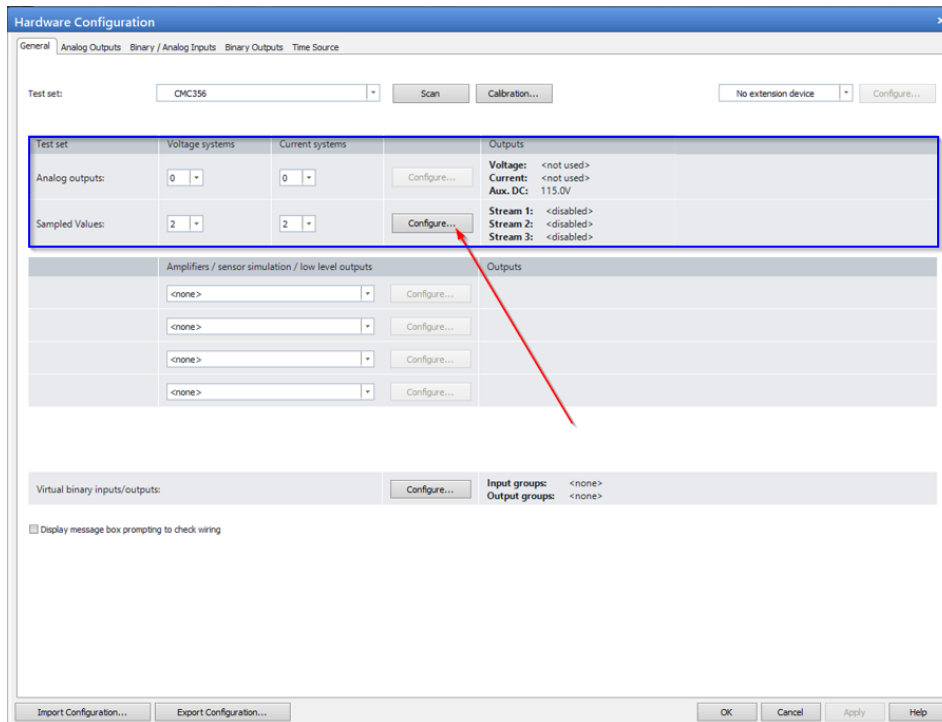


Figure 25. Hardware Configuration - General

Click on Configure on the Sampled Values section for further settings.

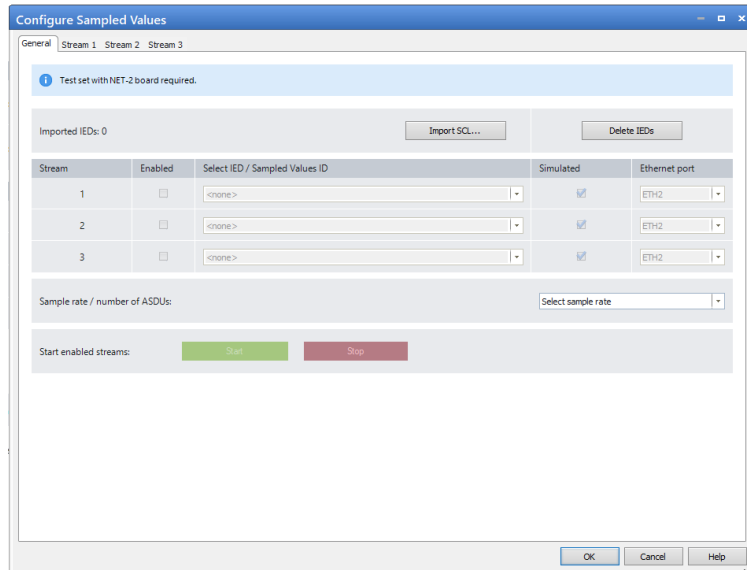


Figure 26. Sampled Values Configuration

You can import your configuration and use the parameterized SV to be used. For that use the Import SCL button.

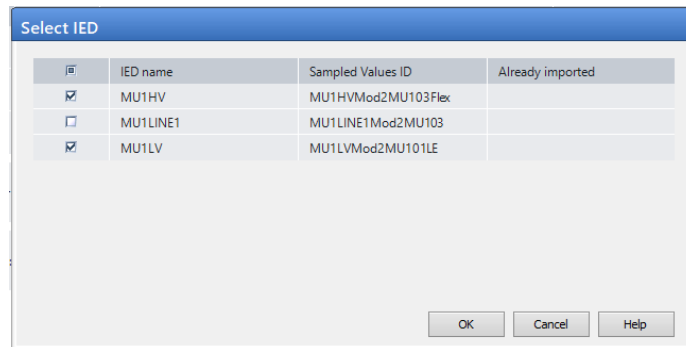


Figure 27. SCL Import

Assign Stream 1, 2, and/or 3 with available SV streams from the SCL and select the sample rate to be used.

Set simulation bit TRUE (enabled) or FALSE (disabled) per stream. Remember, if you are working in an energized station, you should only inject streams with the corresponding simulation bit in TRUE.

Assign the correct Ethernet port.

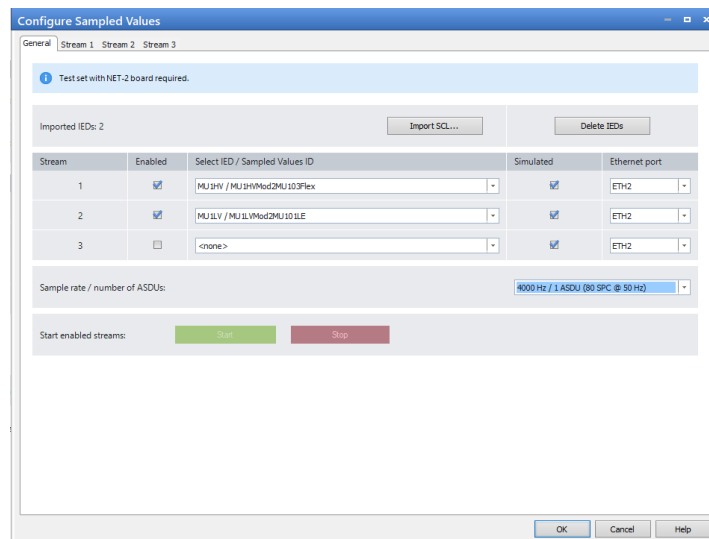


Figure 28. Sample Values Configuration - General

Go to the Stream 1, 2 or/and 3 tabs to assign each stream to a Dataset. For that use the button "Dataset Mapping".

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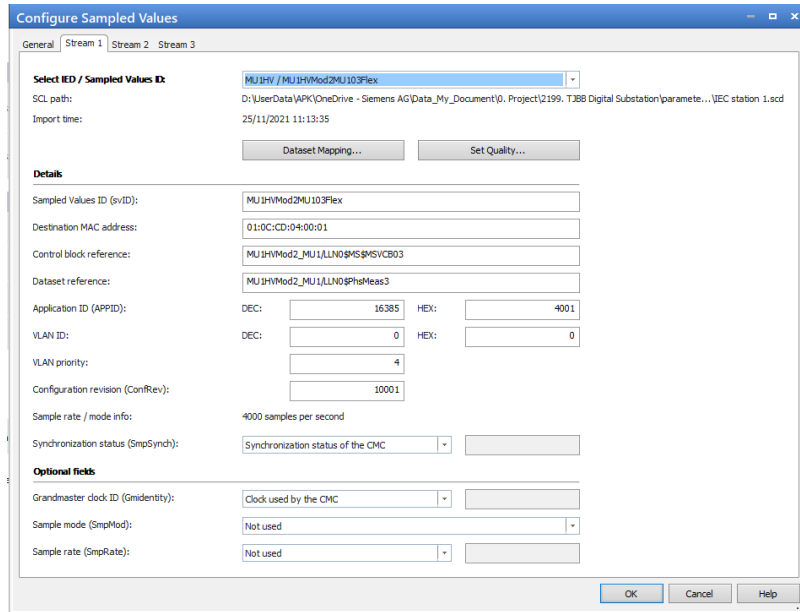


Figure 29. Sample Values Configuration – Stream 1

Assign/Map the display name to the data attribute and click on OK

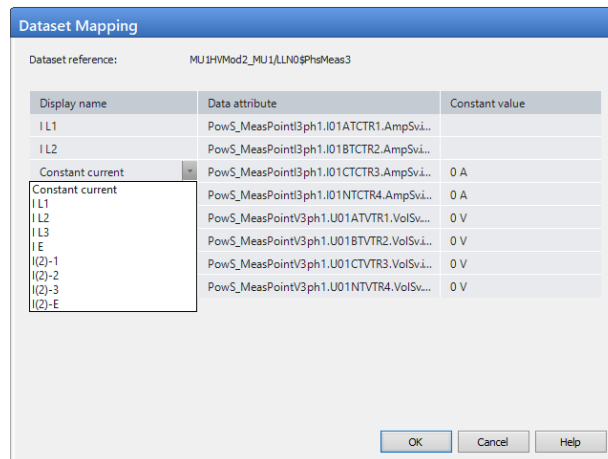


Figure 30. Sample Values Configuration – Stream 1 – Dataset Mapping

In the next step you will need to connect the sampled values to be simulated to the physical outputs of the Omicron device. It is the way the device has been designed. For that , go to Hardware Configuration.- Analog Output and assign the test module output signals.

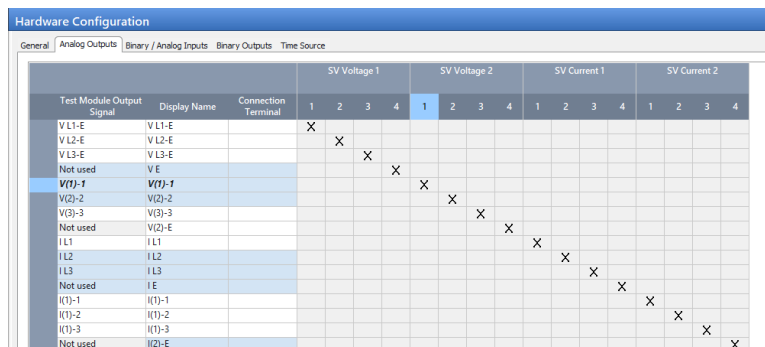


Figure 31. Hardware Configuration – Analog Outputs

Additionally. Make sure the Omicron is synchronized to the same source of the client and server devices. Go to Hardware Configuration. Tab Time Source, and select the time synchronization method.

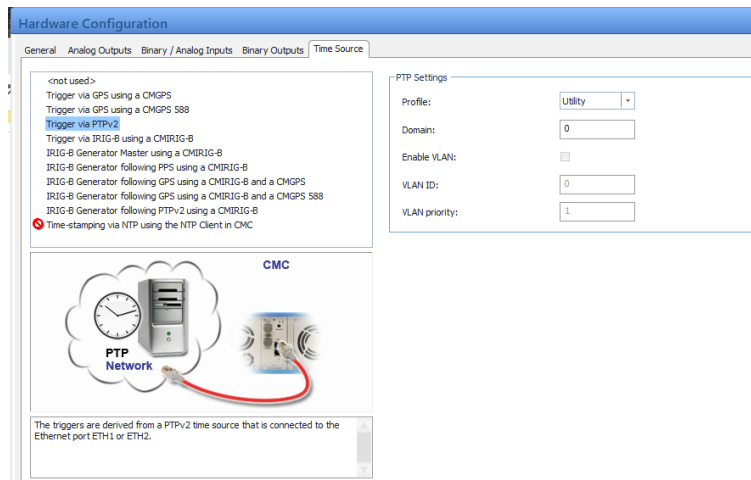


Figure 32. Hardware Configuration – Time Source

Once the sampled values have been configured, proceed with the preparation of the test. In this case the State-Sequencer.

Notes:

1. Goose Messages are configured as usual in the IEC 61850 - GOOSE Configuration Module

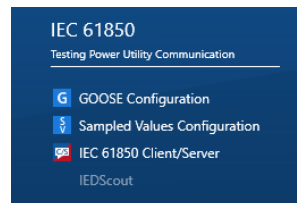


Figure 33. IEC 61850

2. Hardware configuration in module QuickCMC does not have Time Source tab. It means the SV generated by Quick CMC will not be time-synchronized.

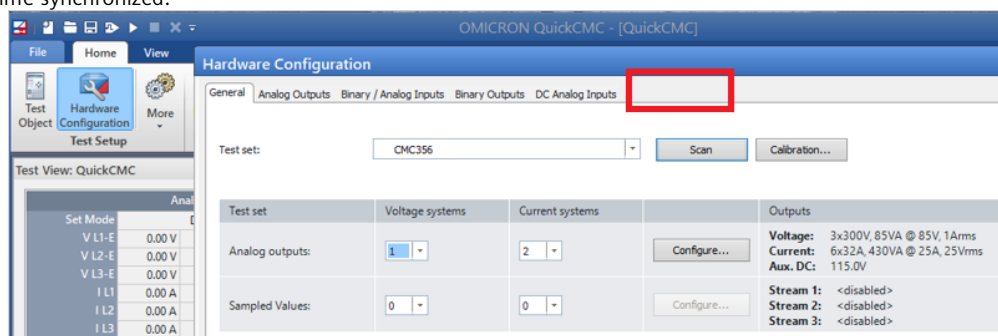


Figure 34. Quick CMC

The manufacturer advises, as workaround for this specific case, to use the "old" Sampled Measured Values Configuration with the QuicCMC. The synchronization is then set in the global Hardware Configuration (see description for Version 4.00)

SIPROTEC 5 Application

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1.3.4.2 Omicron Test Universe 4.00

It will be roughly explained the use of the Omicron CMC356 set with the Test Universe 4.00. In this version only IEC61850-9-2LE streams are supported. Note that an additional license (SMV/GOOSE extension) will be required.



Figure 35. Omicron IEC 61850 extension

To start with the configuration, select the option “Sample Values Configuration” in the Test Universe software (see Figure 35.).

Omicron CMC device must be synchronized by the same signal synchronizing merging units and protection devices. In our example, a PTP signal is used.

Go to Hardware Configuration and then click on time source to set up the PTP signal. In our case in the lab the CMC doesn't support the PTP signal directly and an additional IRIG-B converter is required. Please note that your options can vary depending on the HW you have available.

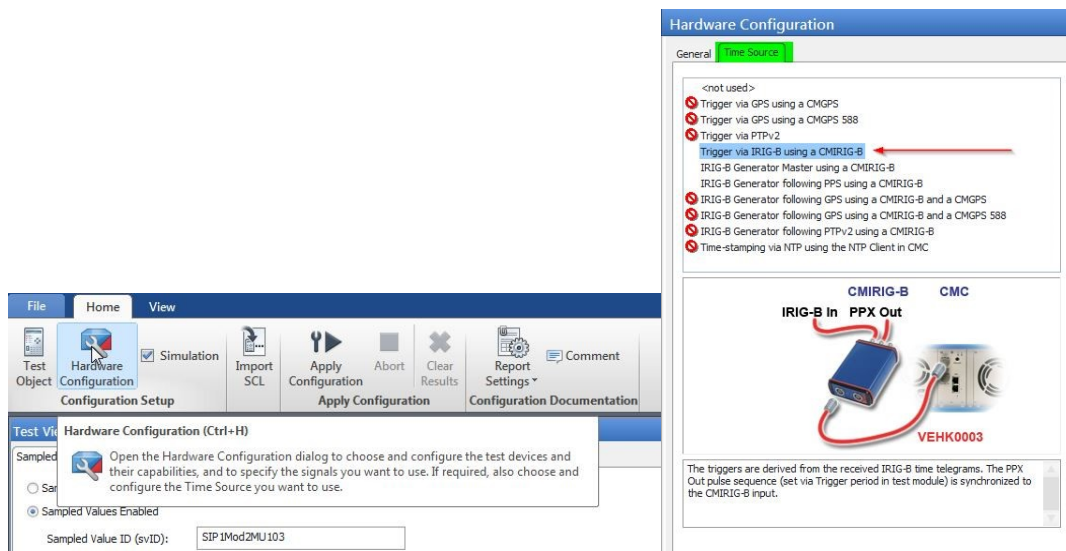


Figure 36. Omicron CMC configuration of time source

Then go to Hardware Configuration – General and assign the ethernet port to be used. For the synchronization use the “CMC Synch status” option. With it, the simulated values will be synchronous with the merging units and protection devices.

In the same menu you can select the appropriate ethernet port, which publishes the SMV streams and is connected to the process bus network (in example below ETH1), and the sampling frequency.

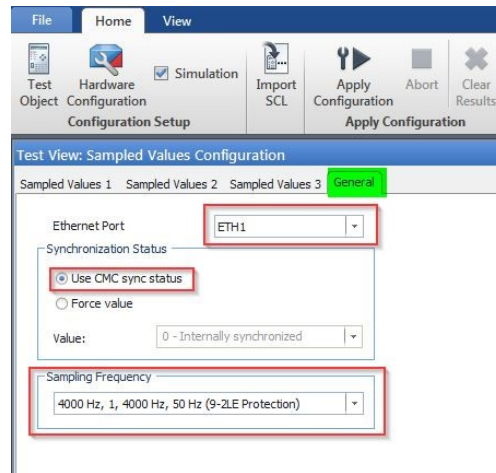


Figure 37. HW configuration – General, in Omicron Sampled Values

A green lock in the status bar signals the proper synchronization of the CMC.

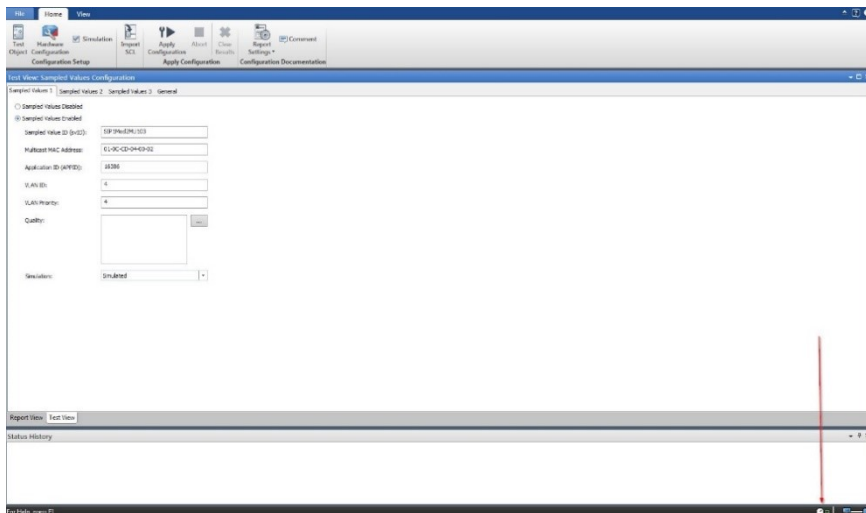


Figure 38. Omicron CMC synchronized

The parameterization data of the sampled values to be simulated can be imported with the option "SCL Import". The information can be also added manually.

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Process Bus IEC 61850 Simulation & Test

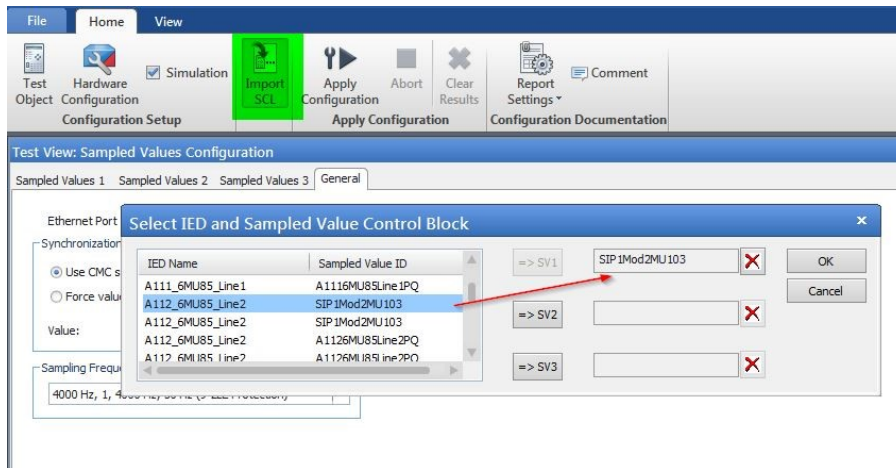


Figure 39. Importing SV in OMICRON Software

The software allows the parameterization of 3 sampled values but as the system uses the existing hardware, only two sampled values streams can be simulated simultaneously. If you are working on a real operating system, **make sure you set the "Simulation Flag" before applying the configuration**, otherwise sampled values streams without simulation bit will be sent to the network, which will cause confusion and misbehavior of the protection devices, as two process streams (from merging unit and simulation device) will be present in the network.

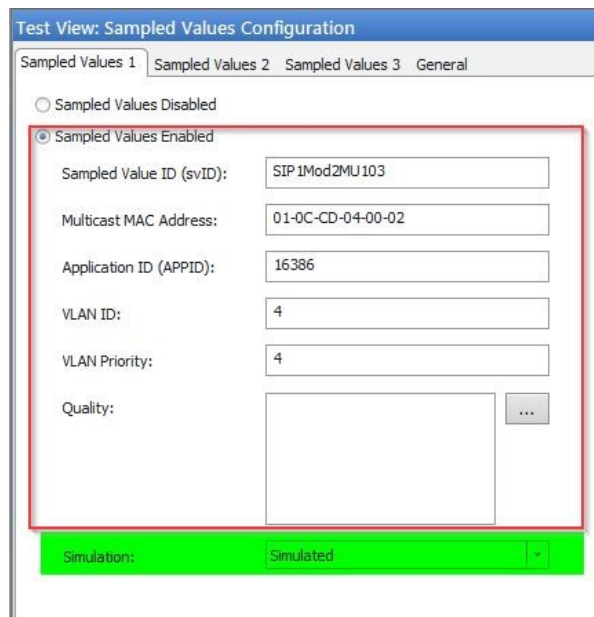


Figure 40. Stream configuration

To run an injection, you must handle the OMICRON as when conventional measurements. Once the injection is activated, select the option "Apply Configuration" in the "sampled values Configuration" Tool

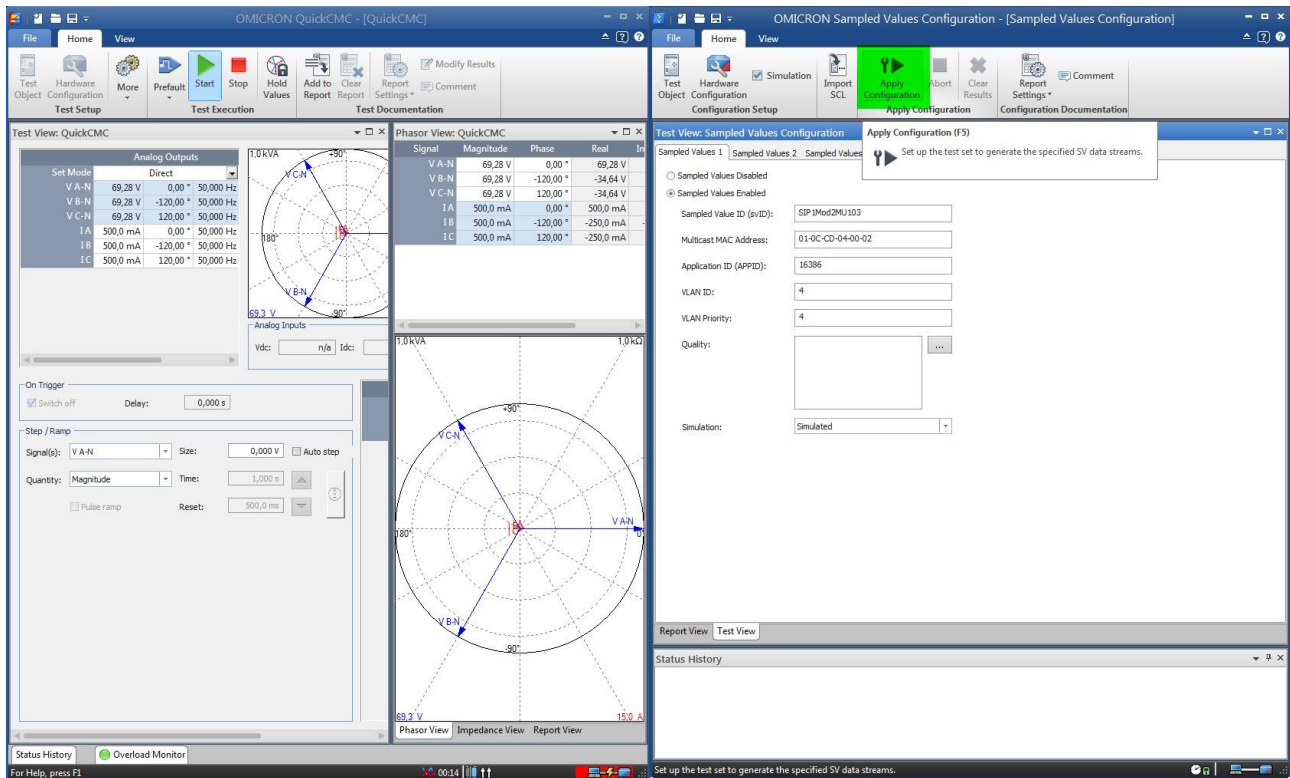


Figure 41. Stream injection

1.4 Test Mode according to the IEC 61850

The data modeling in IEC 61850 is described in the part 7-4. A logical device LD contains one or more logical nodes LN and each LN contains several Data Objects. One of those data objects is the “mode” (**LLNO.Mod**), a controllable signal which can be changed by operator either by a remote command or as result of an IED local action, and can take five different states:

- **On**: application is operative and communication features are in service
- **Blocked**: as “On” but no output data (wired contacts or analog setpoints) are sent to process
- **Test**: as “On” but signals are marked as being produced under test conditions and only control commands marked as test are executed
- **Test/blocked**: as “Test” but no output data (wired contacts or analog setpoints) are sent to process
- **Off**: application is disabled, communication output is provided with data quality ‘invalid’

Other data object is the “behaviour” (**LLNO.Beh**). The value for the overall behaviour (**LLNO.Beh**) of a domain LN results from the current operating mode of the entire LD and the current operating mode of the LN that contains it, as shown in the Figure 44 – Behaviour values as a function of mode, in the IEC 61850-7-4:2010-03+AMD1:2020-02. As an example, if the mode at the LN level is “blocked” and the mode at the LD is “test” the resultant behavior of the LN is “test/blocked”

SIPROTEC 5 Application

Process Bus IEC 61850 Simulation & Test

LN Mod	LD Mod	LN Behaviour
on on on on on	on blocked test test/blocked off	on blocked test test/blocked off
blocked blocked blocked blocked blocked	on blocked test test/blocked off	blocked blocked test/blocked test/blocked off
test test test test test	on blocked test test/blocked off	test test/blocked test test/blocked off
test/blocked test/blocked test/blocked test/blocked test/blocked	on blocked test test/blocked off	test/blocked test/blocked test/blocked test/blocked off
off off off off off	on blocked test test/blocked off	off off off off off

Table 1. LN Behaviour (example highlighted)

How the device shall react according to its "behaviour" and depending on the type of signal arriving and its quality is described in the Table A.2 – Definition of mode and behaviour, of the IEC 61850-7-4:2010-03+AMD1:2020-02 Standard.

Following options are given in the standard:

- "Processed as valid" means that the application should react according to the quality and the intended functionality of the LN.
- "Processed as invalid" means the application should react as if the quality of the data is not valid or as if the data source has failed.
- "Processed as questionable" means that the application should decide how to consider the status value.

1.4.1 Implementation in SIPROTEC 5 devices

The SIPROTEC 5 devices included since the first release a special set of settings to support the testing functionality. This "Test Support" menu is available in DIGSI 5 under "device settings".

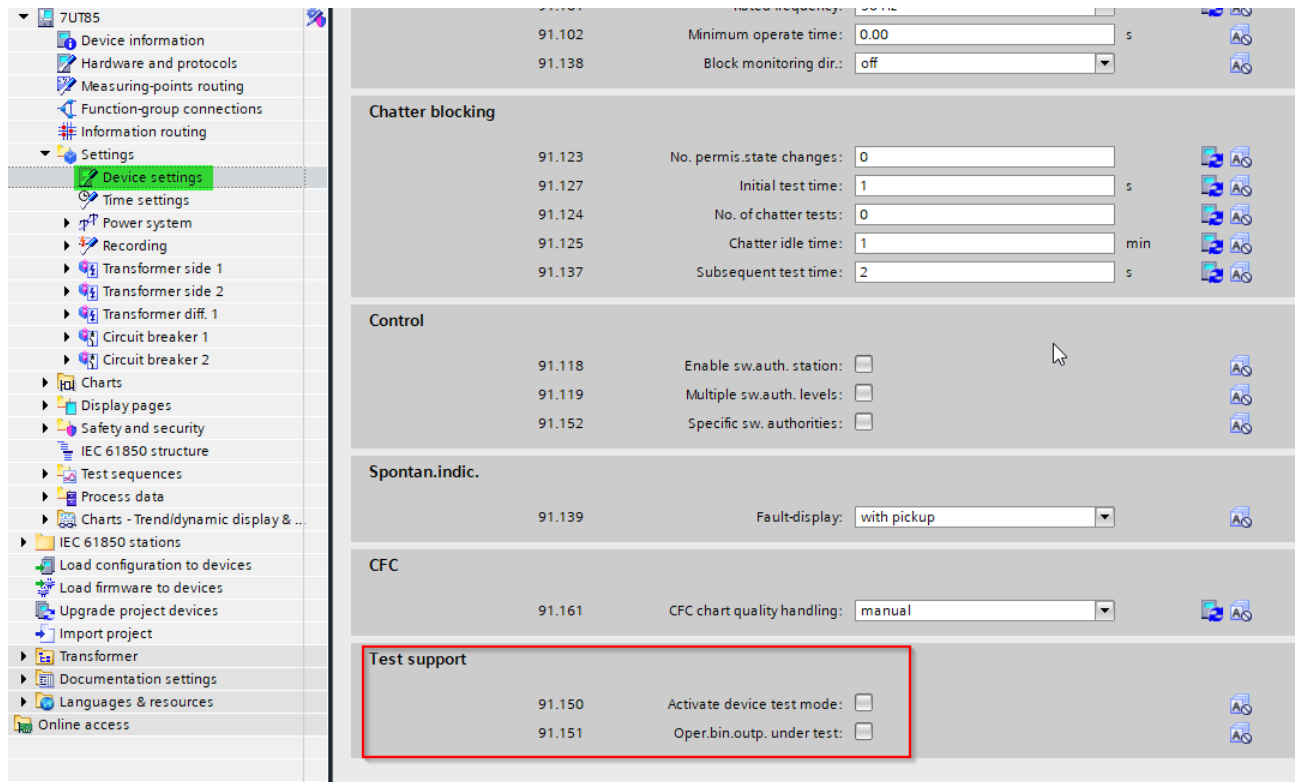


Figure 42. Test support menu in DIGSI 5

This menu allows the following two actions:

1. Setting 91.150 (Signal **EnTestMod**): to set a test mode for the complete device, so, indications issued via communication interfaces are labeled with an additional test bit, if this is supported by the protocol
2. Setting 91.151 (Signal **RelBoOnTstMod**): to allow the operation of the binary outputs even if the device is in test (**EnTestMod=True**). By default (**RelBoOnTstMod=false**) the outputs will be blocked when the **EnTestMod** has been enabled.

The two mentioned signals, **EnTestMod** and **RelBoOnTstMod**, together with the controllable signal **LLN0.Mod** described in chapter 1.4 affect the behaviour of the LLNO logical node (**LLN0.Beh**).

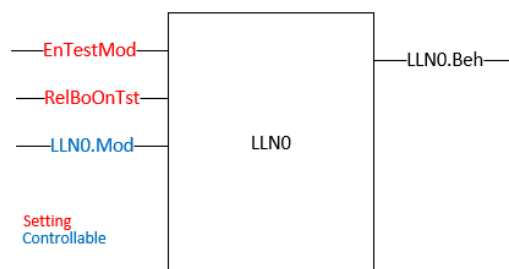


Figure 43. Behaviour of LLNO in SIPROTEC 5

On the other side, there are some differences in the implementation of the Test Mode in the firmware version V8.0x. and from the FW V8.30 and on. The following table shows a summary.

SIPROTEC 5 Application

Process Bus IEC 61850 Simulation & Test

Feature	FW V8.0x	FW V8.30 or higher
Function Name	Test Mode	Application Mode
Blocked Mode	Not available	According to IEC 61850
Test Mode	Functionality available directly via IEC 61850. Setting 91.151 "Oper.bin.outp. under test" in DIGSI must be set to true. Via IEC 61850 LLN0.Mod can be set to "3" and behaviour is "3"	According to IEC 61850 Please note that if the setting 91.151 "Oper.bin.outp. under test" in DIGSI = false, the behaviour will be Test/Blocked (4)
Test/blocked Mode	Functionality available but not directly via IEC 61850. Setting 91.151 "Oper.bin.outp. under test" in DIGSI must be set to false. Via IEC 61850 LLN0.Mod cannot be set to "4" but the binary outputs are not activated when LLN0.Mod is set to "3".	According to IEC 61850

Table 2. Test mode differences for different FW versions

The "Test Mode" name was kept for upgradeability of former versions and the name "Application Mode" was added to include the complete functionality according to the IEC 61850 Standard.

Signals	Number	Type
(All)	(All)	...
Sw.mode key/set	91.310	ENS
Behavior	91.52	ENS
Health	91.53	ENS
Test mode	91.51	ENC
Application mode	91.56	ENC
Protection on	91.321	SPC
Protection inactive	91.54	SPS
Device logout	91.319	SPC
Logged off via BI	91.313	SPS
Logged off via control	91.314	SPS

Figure 44. Test and Application mode signals in DIGSI 5

For an easier visualization of the above-mentioned implementation see below a summary table:

LLN0.Mod	EnTestMod	RelBoOnTst	LLN0.Beh	<V8.30	>= 8.30
On	True	False	Test/Blocked	Ok (but shown as "Test" (3)*)	ok
Blocked	True	False	Test/Blocked	not available	ok
Test	True	False	Test/Blocked	Ok (but shown as "Test" (3)*)	ok
Test/Blocked	True	False	Test/Blocked	not available	ok
On	True	True	Test	ok	ok
Blocked	True	True	Test/Blocked	not available	ok
Test	True	True	Test	ok	ok
Test/Blocked	True	True	Test/Blocked	not available	ok
On	False	False	On	ok	ok
Blocked	False	False	Blocked	not available	ok
Test	False	False	Test/Blocked	ok	ok
Test/Blocked	False	False	Test/Blocked	not available	ok
value	False	True	value		

Table 3. Summary table of LLN0 Behavior

*as explained in the Table 2.

As it can be seen in the Table 3, the parameters 91.150 (**EnTestMod**) and 91.151 (**RelBoOnTst**) must be set to false and true respectively in order to grant a response of the device as foreseen in the IEC 61850 Standard. Be aware, that the outputs are then by default **NOT blocked**, and this is the opposite behaviour to what we got used to in the past.



Figure 45. Test support menu in DIGSI 5 - recommended setting

1.4.2 Behaviour of a logical node LN in SIPROTEC 5 devices

In the SIPROTEC 5 devices, the "behaviour" (**LN.Beh**) of the LN considers in addition to the conditions described in 1.4 above, the "mode" (**LN.Mode**), which corresponds to the Siemens setting of the function.

This means: **LN.Beh** = F (**LN.Mode**(*Siemens Setting*), **LN.Mod**(*IEC Controllable*), **Application_LLNO.Beh**(*IEC Controllable*))

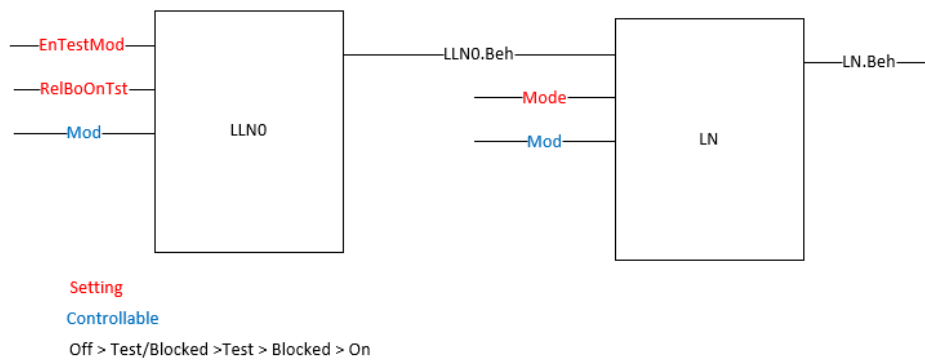


Figure 46. Behaviour of LN in SIPROTEC 5

See in the following example the Behaviour result in blue (**LN.Beh**) and the signals involved in the evaluation in green (**LN.Mode**(*Siemens Setting*), **LN.Mod**(*IEC Controllable*), **Application_LLNO.Mod**(*IEC Controllable*)) for the TR_PDIF1 protection function.

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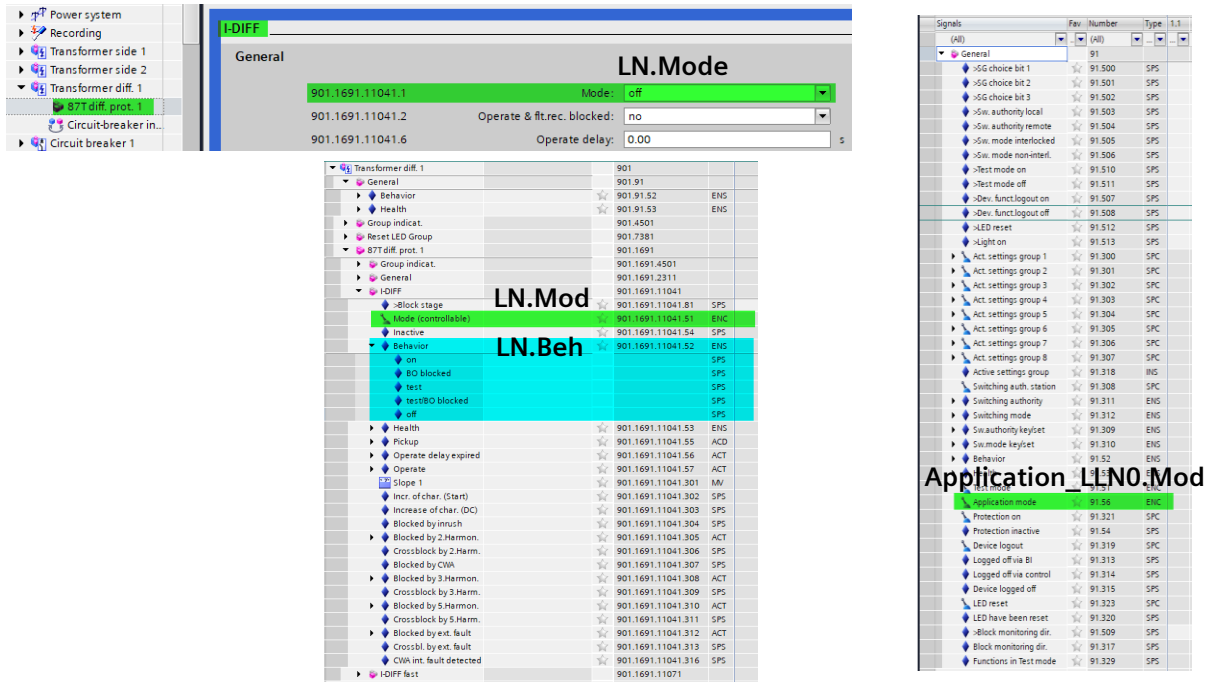


Figure 47. Controllable signals included in the behaviour of the TR_PDIF1 in DIGSI 5

For an easier visualization see below a summary table:

LLN0.Beh	EnTestMod	RelBoOnTst	LN.Mode	LN.Mod	LN.Beh
any value	False	True	Off	any value	Off
any value	False	True	any value	Off	Off
value	False	True	On	On	value
On	False	True	On	Value	value
On	False	True	Value	On	Value
Blocked	False	True	On	Test	Test/Blocked
Blocked	False	True	Test	On	Test/Blocked
Blocked	False	True	Test	Test	Test/Blocked

Table 4. Summary table of LN Behavior

⚠ Please note that the test mode at the function level is only relevant for GOOSE messages. Sampled Values follow only the general Test Mode of the complete device (**Application_LLN0.Beh**).

1.4.3 Setting the Test Mode in SIPROTEC 5 devices

In the SIPROTEC 5 devices it is possible to change the test mode of the complete device (**Application_LLN0.Mod**) or some individual functions (**LN.Mod**) via IEC 61850. The Individual functions can be also locally modified in the device by changing the corresponding setting (**LN.Mode**). As seen in the previous chapter a combination of them all give the final behaviour of the function.

For example, if the complete device has been set to test, all individual functions will include this “test” in the calculation of their behaviour. Therefore, if an individual function is in ON (Mode and Mod), the final behavior will be “Test”, but if it is Blocked (Mode or Mod), the final behavior will be “Test/blocked”.

Be aware of the precedence order:

Off > Test/Blocked > Test > Blocked > On

When the final “behaviour” of the function is set to test or test/blocked the device marks indications, also SMVs and GOOSE, sent out with an additional test bit. This test bit makes it possible to determine that an indication was set during a test and avoid unnecessary reactions in the receiving devices or systems.

1.4.3.1 Setting the complete device in test mode

The test mode can be changed for a complete device by setting the **LLN0.Mod.Oper.ctlVal (General:Application mode)** (>=V8.30).

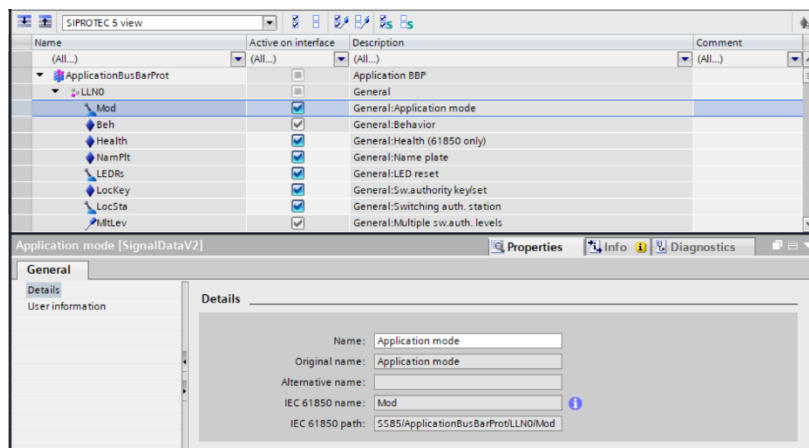


Figure 48.DIGSI 5 - IEC 61850 Test controllable signal

The values below are allowed by the Standard:

1. on
2. blocked
2. test
4. test/blocked
5. off

a) Using Siemens IEC Browser

One option to set the mode is using the SIEMENS IEC-Browser. First make sure you **Enable Write** in the “Extras” Menu, as shown in the Figure 4. Then, go to the Application, select the general logical node LLN0, go to CO-(Command) and click-right on the “Mod” Control:

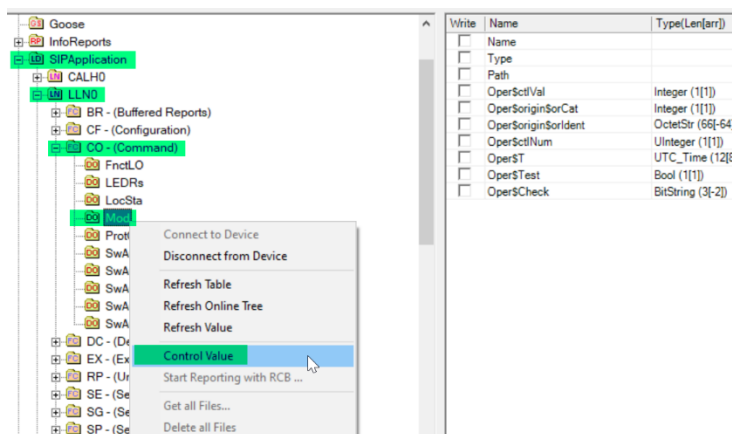


Figure 49.SIEMENS IEC-Browser: Mode controllable signal

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As soon as the control dialog appears, you can set the test mode by entering the number of the desired state. Note that we can not operate Application_LLNO to off via IEC 61850.

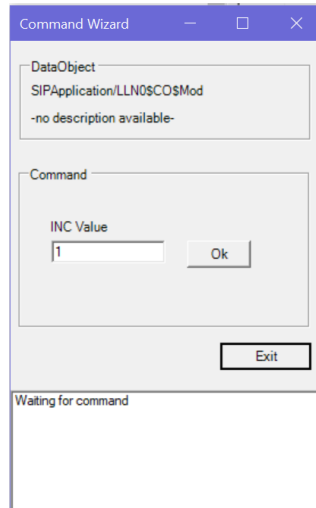


Figure 50. SIEMENS IEC-Browser: Test Mode Signal Control

The controllable “LLNO.Mod” according to IEC 61850 can also be switched from a SICAM SCC interface via IEC61850-8-1 MMS. See string example in the annex A.

b) Using local display

The test mode can be also changed from the display of the device. The corresponding menu can be found under:

Device Functions → Operation Modes → Application mode

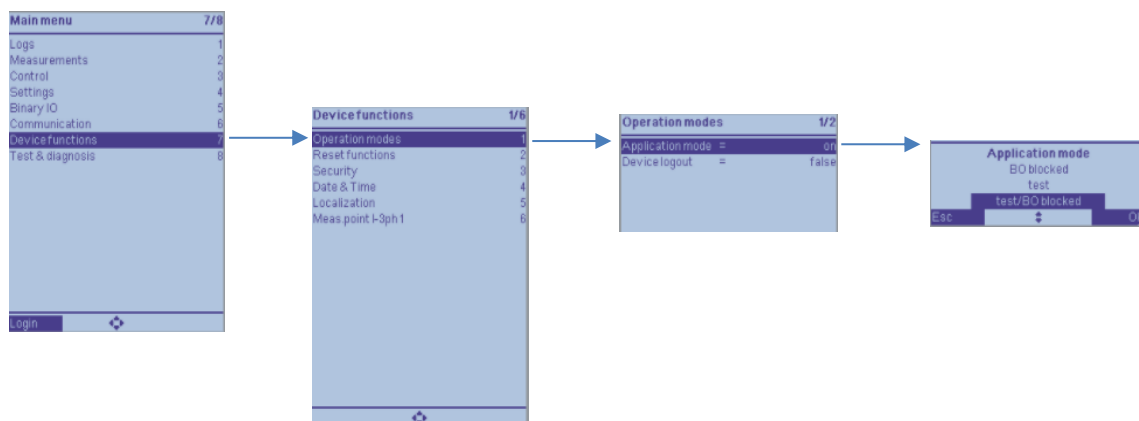


Figure 51. Test mode change from operator panel in V8.30 or higher

1.4.3.2 Setting individual functions in test

It is also possible to change the mode of individual functions in the lower hierarchy level as shown in the Figure 32. Remember that the resultant behavior depends on the mode of the logical device and the setting as well.

a) Using Siemens IEC Browser

Follow the same procedure described before for the lower hierarchical level of a function.

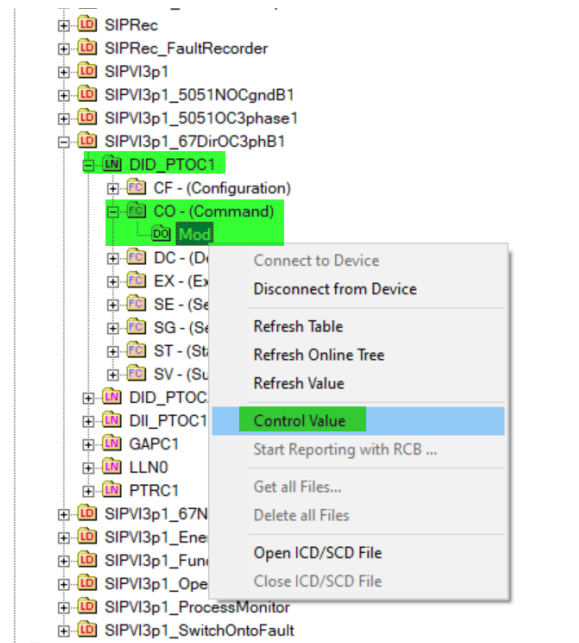


Figure 52. SIEMENS IEC-Browser: Mode controllable signal of individual functions

b) Using local display

From the operator panel it is only possible to set the **setting Mode** to on, off or test.

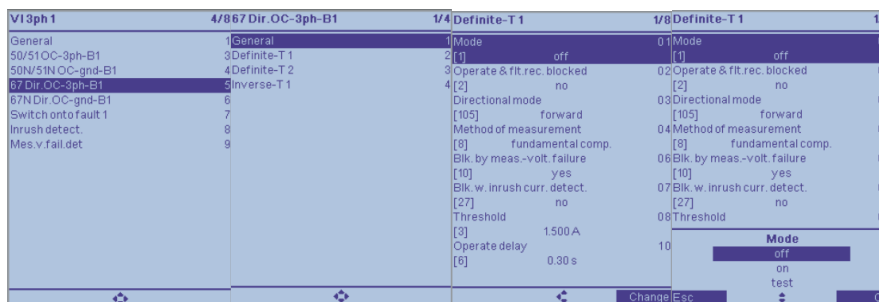


Figure 53. Mode change from operator panel in V8.30 or higher

Please note that if you change mode using the local display, you are acting on the Setting **“Mode”** and not on the controllable **“Mod”** of the IEC 61850. The setting **“Mode”** can be also marked to be available in the IEC 61850 communication, so it can be remotely modified.

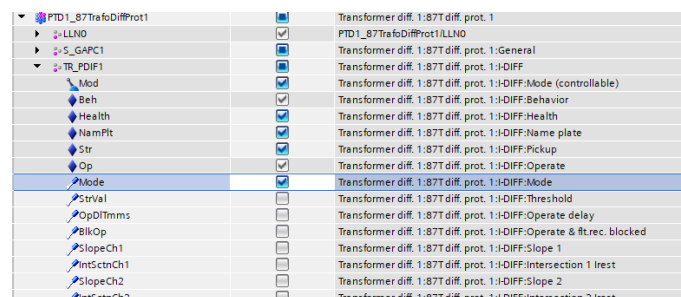


Figure 54. Mode Signal enabled to IEC 61850 transmission

1.5 Sampled Values and GOOSE supervision

The supervision of sampled values LSVS and GOOSE messages LGOS is also supported in SIPROTEC 5 according to the definition of the IEC 61850-7-4 Edition 2 and higher. These logical nodes can be used to easily monitor GOOSE and SV communication.

The logical nodes LSVS and LGOS are used to supervise if a sampled value subscription (SV subscription) or GOOSE subscription, correspondingly, operates normally.

Following data objects are used for sampled values:

- **St:** The status of the subscription (BOOL) can be true or false. If this value is true, the LSVS indicates that the monitored sampled values are provided and forwarded to the application and that the status is OK.
- **SimSt:** The simulated or true data (BOOL) can be true or false. For further information, refer to the IEC 61850-7-1 standard. When true, the subscription is accepting simulated data and forwarding it to the application.
- **ConfRevNum:** Revision number of the configuration. The MU sends data with configuration revision. The client expects a certain configuration revision. A mismatch of the ConfRevNum can be solved with a roundtrip in the IEC 61850 System Configurator.
- **SvCRef:** Reference of the supervised subscribed SV stream
- **Siemens-specific error status:** These error statuses can be:
 - General errors on the subscription, with information of the cause for false
 - Time-synchronization errors

Error	Status	Meaning
DiagErrSmv	LDES_NoError = 0	The SV subscription works without errors.
	LDES_WaitingForTelegram = 1	At the moment, no telegrams are received for the corresponding SV subscription.
	LDES_SmpCntJump = 6	SV data for the corresponding SV subscription has been lost.
	LDES_Initializing = 7	The corresponding SV subscription is being initialized.
	LDES_GeneralError = 9	A general error has been detected for the corresponding SV subscription.
	LDES_ConfRev mism.	Not being used currently, will be hidden or enabled in future version
	LDES_ConfRev miss.	
	LDES_SV ID mism.	
	LDES_Appl. ID mism.	
	LDES_Broken telegr.	Currently, there is an internal problem with data buffering of the SV Stream. If this indication persists for a longer period of time, it is possible that publisher and/or subscriber of the affected SV stream are not correctly time-synchronized. However, a temporary occurrence of this indication does not indicate an error and is possible in the following cases: <ul style="list-style-type: none"> • The publisher and/or subscriber of the SV stream are switched on. • The time source changes. • The time-source status changes.
LDES_Data delay error = 10		
DiagSynch	LDS_Initializing = 0	The time synchronization of the corresponding SV subscription is being initialized.
	LDS_GlobalTimeSynch = 1	The time synchronization source meets the required accuracy and is time traceable.
	LDS_LocalTimeSynch = 2	The time synchronization meets the required accuracy and is not time traceable.
	LDS_GeneralError = 3	The time synchronization of the corresponding SV subscription indicates a general error.
	LDS_NoTimeSynch = 4	The time synchronization of the corresponding SV subscription is not active or does not meet the required accuracy.
	LDS_SmpSynchMismatch = 5	The time synchronization of the SV subscription is in a state other than global and this state is not allowed in the subscriber per 102.1031.0.106 SmpSynchId.
	LDS_SynchSrcIdMismatch = 6	The time synchronization of the SV subscription is in state local but is synchronized from a different time source compared to the subscriber.

Table 5. SV error status

Following data objects are used for GOOSE Messages:

- **NdsCom**: If the value is TRUE, this indicates that the parameterization of the subscription is faulty. You can find detailed information in the object DiagErr.
- **St**: If the value is TRUE, the GOOSE connection is active. If the value is FALSE, the GOOSE connection is inactive.
- **SimSt**: If the value is TRUE, GOOSE messages with set simulation bit are accepted. For this, you must switch the device to the GOOSE simulation mode. If GOOSE messages with set simulation bit are no longer received, the value remains TRUE until the simulation is turned off.
- **ConfRevNum**: This object contains the expected ConfigRev number according to GOOSE parameterization.
- **RxConfRevNum**: This object contains the received ConfigRev number of the GOOSE connection. This number must match the ConfRevNum, otherwise, NdsCom is set to TRUE and you must adapt the parameterization.
- **DiagErr**: This object contains the following information in case of GOOSE-connection errors:
 - 0: NoError
 - 1: WaitingForTelegram
 - 2: ConfRevMismatch
 - 3: GoIDMismatch
 - 4: DataSetReferenceMismatch
 - 5: NeedsCommissioning
 - 6: DataSetMemberMismatch
 - 7: Initializing
- **GoCRef**: This object contains the object reference of the monitored received GOOSE control block.

The GOOSE supervision must be activated with the setting Enable GOOSE Supervision in DIGSI 5 under Settings > Device settings. This option can be only enabled for devices with IEC 61850 Edition 2 or higher. Moreover, the GOOSE supervision requires a FW V7.80 or newer. The corresponding configuration must be done in the IEC 61850 System Configurator. For Siemens devices the supervision node will be automatically created when the subscription is parametrized.

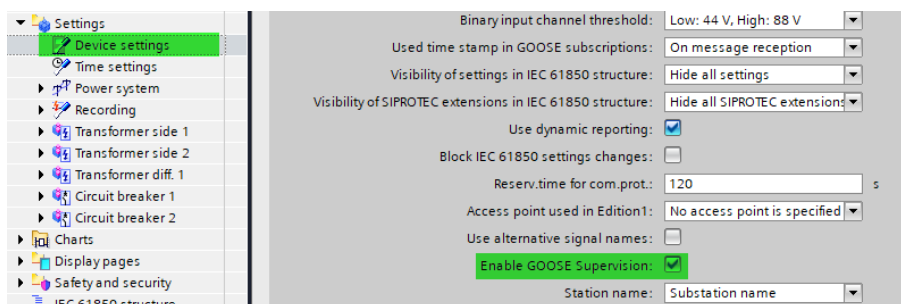
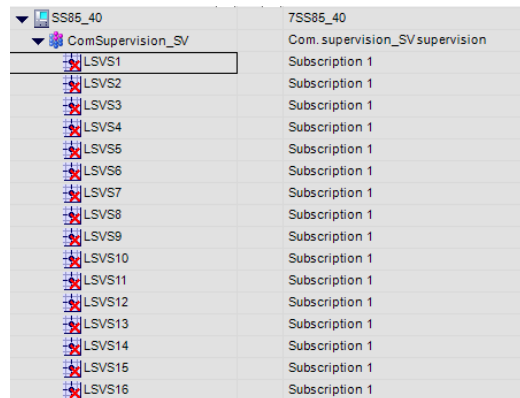


Figure 55. GOOSE supervision enabling

The Sample Value (SV) supervision is enabled automatically when the process-bus 9-2 Client protocol is activated in the ETH-BD-2FO module. One supervision block will be created for each subscribed stream. The configuration must be done in the IEC 61850 System Configurator. For Siemens devices the supervision node will be automatically created when the subscription is parametrized.

SIPROTEC 5 Application

Process Bus IEC 61850 Simulation & Test



The screenshot shows a tree view in the IEC 61850 System Configurator. The root node is 'SS85_40', which is expanded to show 'ComSupervision_SV'. Under this node, there are 16 LSVS nodes, labeled LSVS1 through LSVS16. Each LSVS node is associated with a 'Subscription 1'.

Node Name	Subscription
LSVS1	Subscription 1
LSVS2	Subscription 1
LSVS3	Subscription 1
LSVS4	Subscription 1
LSVS5	Subscription 1
LSVS6	Subscription 1
LSVS7	Subscription 1
LSVS8	Subscription 1
LSVS9	Subscription 1
LSVS10	Subscription 1
LSVS11	Subscription 1
LSVS12	Subscription 1
LSVS13	Subscription 1
LSVS14	Subscription 1
LSVS15	Subscription 1
LSVS16	Subscription 1

Figure 56. Configured LSVS in IEC 61850 System Configurator

1.6 Conclusion

The SIPROTEC 5 family is prepared to offer the required support to the challenges brought by the digitalization of the process level.

New ways of testing must be implemented to cover different scenarios without jeopardizing the reliability and safety of the system. As such, it shall be possible to disable or isolate one specific device for replacement or testing purposes without affecting the rest of the system. Using the mechanisms provided by the IEC 61850 standard is possible to achieve that goal. Those mechanisms are given by the proper use of the simulation and test modes.

Moreover, the smoothly operation of the system can be monitored from a central place thanks to the supervision possibilities available through the LGOS and LSVS logical nodes.

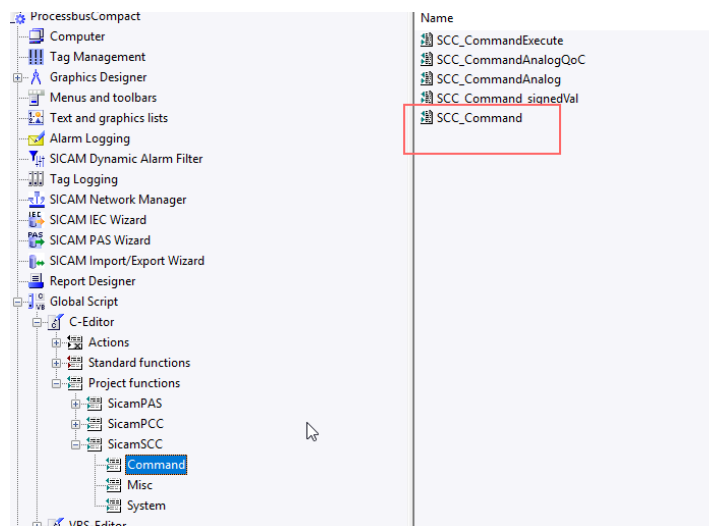
As a general recommendation, set the device in Test before activating the Simulation messages. As a result, the device outputs will be labeled as "test" and will not be used for operation purposes.

Additionally, the parameters 91.150 (**EnTestMod**) and 91.151 (**RelBoOnTst**) must be set to false and true respectively in order to grant a response of the device as foreseen in the IEC 61850 Standard. Be aware, that the outputs are then by default **NOT blocked**, and this is the opposite behaviour to what we got used to in the past.

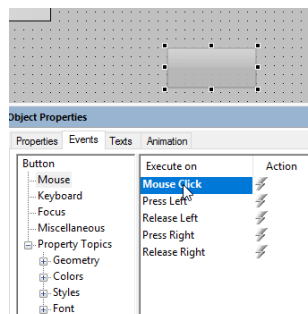
Annex A

Configuration and C-Script example for changing IEC 61850 modes from the HMI- SICAM SCC

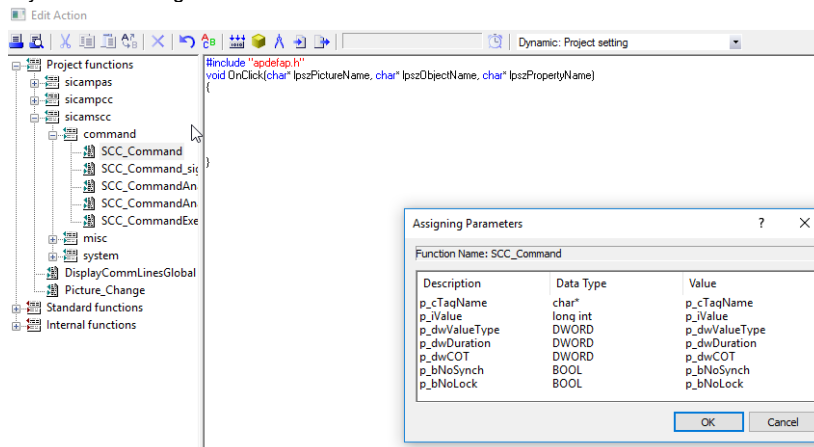
- 1) Details of project functions to be found here when opening Global Script



- a) From SCC towards Siprotec device use commands
- b) Regularly just use this dialog for implementing Command using C-Script. Example to a mouse click of a button



- c) Add C-function by double clicking



- d) Click on "OK" in picture above


```
//  
//  
//#####  
//  
//                COPYRIGHT (c) SIEMENS AG 1999-2017  
//  
//#####  
//  
//    2017-02-24    EM DG PRO D    Muerling    QoC processing changed, parameter description  
digital only  
//  
//    2016-11-02    EM DG PRO D    Hartinger    new for SICAM SCC V9.00, with QoC and Abort  
//  
//    2007-07-04    PTD EA D TC 14 J. Binder    New, enhancement of PAS_Command_Integer_V500  
//  
//#####  
//  
//
```

2) Examples of C-Scripts

a) Example to set a Siprotec in Test Mode 1

```
SCC_Command("ProcessbusCompact_7SL87_Line1_c_Application_General_Test_mode",1,14,1,19,1,1); //Return-Type: void
```

b) Example to set a Siprotec in Test Mode 2

```
SCC_Command("ProcessbusCompact_7SL87_Line1_c_Application_General_Test_mode",2,14,1,19,1,1);
```

c) Example to set a Siprotec in Test Mode 3

```
SCC_Command("ProcessbusCompact_7SL87_Line1_c_Application_General_Test_mode",3,14,1,19,1,1);
```

d) Example to deactivate protection function ANSI 50/51

```
SCC_Command("ProcessbusCompact_7SL87_Line1_c_Ln1_50_511_General_Mode__controllable",1,14,5,19,1,1);
```

e) Example to activate protection function ANSI 50/51

```
SCC_Command("ProcessbusCompact_7SL87_Line1_c_Ln1_50_511_General_Mode__controllable",2,14,5,19,1,1);
```

f) Example to activate Goose/SV Simulation mode

```
SCC_Command("ProcessbusCompact_7SL87_Line2_c_Application_Device_GOOSE_SV_sim_mode",2,14,1,19,1,1);
```

g) Example to deactivate Goose/SV Simulation mode

```
SCC_Command("ProcessbusCompact_7SL87_Line2_c_Application_Device_GOOSE_SV_sim_mode",1,14,1,19,1,19);
```

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