BACnet Browser Test Sequencer

User's Manual

SIEMENS

Version: 1.5

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1 General information

1.1 BACnet

BACnet is a communications protocol for building automation and control networks. It is an ASHRAE, ANSI, and ISO standard protocol. BACnet was designed to allow communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control, lighting control, access control, and fire detection systems and their associated equipment. The BACnet protocol provides mechanisms for computerized building automation devices to exchange information, regardless of the particular building service they perform.

1.2 BACnet Browser

The BACnet browser is a tool that has been developed as an aid to confirm BACnet/IP communications on a network. It can be used with 3rd Party devices to discover BACnet addresses. It can also be used to adjust BACnet object properties.

1.3 Test Sequencer

Test Sequencer is a tool embedded within BACnet Browser, which enables testing BACnet Network by loading scripts delivered in XML format. The scripts can be designed in MS Excel and easily converted to XML format. All devices in the BACnet Network can be tested according to designed script.



Figure 1. Test Sequencer Operation

The test results can be exported and saved in CSV representation. Test Sequencer is useful tool for system testing especially while commissioning a system.

1.4 BACnet Network

Any BACnet devices, connected to the same BACnet Network are able to exchange data values. Desigo PX uses three forms of BACnet communications, BACnet on LON, BACnet on IP (Ethernet) and BACnet MSTP. BACnet Browser enables access to all devices available on the network using IP router. Moreover, all BACnet objects can be easily modified and adjusted according to user preferences.



Figure 2. Example BACNet Network

2 Installation

Open *BACnetBrowser_v2.0_Setup.exe* and install BACnet Browser on PC by following installation instructions. Once it is finished open BACnet Browser and register the product. In the main toolbar go to "Help" and "Registration". This tool is free issued. Once this is installed on a PC an Installation code is produced. This code must be e-mailed to <u>cpstechsupport.sbt.uk@siemens.com</u> in order for a Registration Code to be generated to activate the tool. Once registration is successful, the registration window will indicate that BACnet Browser is registered.

Registration		_O×
BACnet Brow	ser is registered!	
Installation Code:	1151394092-25-1	
Registration Code:		
Cancel	ок	

Figure 3. BACnet Browser Registration

3 BACnet Browser configuration

Before you start working on BACnet Browser it is required to configure the network. Go to "File", "Settings" and Select IP addresses of the computer to obtain communication with BACnet (Figure 4).

nterface	192.168.0.157	BACnet nort
ort	47608	BHOnet port
levice ID	4194303	
VPOU Timeout	3000	BACnet Device ID of
efault Property	77	BACnet Browser
foreign Device	1	
EMD Port	47868	
TL .	360	
	Add Tree Details	

Figure 4. BACnet Browser IP Settings

Expand the "File" menu in the main toolbar and click "Send Who-Is". All available BACnet networks will be displayed (Figure 5). Next by double click on chosen network expand list and all available devices in the chosen network will be displayed.

💮 BACnet Browser			
File Help	🔅 BACnet Browser		
File Help Settings Send 'Who-Is' Find Device Export Run Server Load Test Sequencer Exit	BACnet Browser File Help File Local Network File Network 702 File Network 703	BACnet Browser File Help Good Network Metwork 702 Metwork 703 Device 2098178 "Site01'AS02" Device 2098179 "Site01'AS03"	BACnet Browser File Help Image: Straight of the straight of
J			Image Service Imalog Service <t< td=""></t<>
		J.	I inalog Output 5

Figure 5. BACnet Browser Configuration

Repeat the same steps with "Devices" in order to access to device inputs, outputs, etc.

See example Analog Input 1 (Figure.6).

Help			
III Network 702	- 51	EMENS	
III Network 703			
- C2 Device 2090176 Siteo1 ASU2	22	cov increment	0.200000
Analog Input 2	28	description	"14th Fire alarm State"
Analog Input 2	36	event state	fault
Analog Input 4	75	object identifier	Analog Input 1
Analog Input 5	77	object name	"B'AS'AHU14'14FireSta"
Analog Input 6	79	object type	Analog Input
Analog Input 7	81	out of service	FALSE
Analog Input 8	85	present value	0.000000
🔁 Analog Input 9	103	reliability	Reserved for Use by ASHRAE
😔 Analog Input 10	106	resolution	0.100000
- 🐼 Analog Input 11	111	status flans	{true.true.false.false}
- 🐏 Analog Input 12	117	units	no-units
- 🐏 Analog Input 13	168	profile name	"7-BA-PX-AT RED-SBCv05 10"
🕀 🖈 Analog Input 14	3000	user designation	m
- 🐏 Analog Input 15	3001	reference to higher object	Hierarchy 4
Analog Input 16	3005	element type	4
Analog Input 17	3006	object tag	22
Analog Output 1	3008	low value	-3402822046616616342000000000000000000000000000000000000
Analog Output 2	2000	biabuslus	240282204661661624200000000000000000000000000
Analog Output 3	3016	mercage text	Noll
92 Analog Output 4	2017	dese	1 000000
Analog Output 5	- 4	No me	

Figure 6. BACnet Analog Input 1

4 Test Setup

4.1 Create Test

BACnet Browser provides unique functionality to design and execute various tests useful while commissioning a system. Testing operations are carried out in Test Sequencer which is the tool embedded within BACnet Browser.

BACnet test can be easily designed in MS Excel and translated to XML format. There seven main fields which are crucial while designing the test. These are:

Sid	number of the action
Name	description of the action
Read	subscribe value to variable
Format	display format
Test	logical condition
Write	send value out to network
Sleep	delay

Each script can have row/device specific 6 local variables: A, B, C, X, Y, Z and 2 global test wide variables: G1, G2. All variables are mainly used for "read" and "write" functions, but also can be used to store values, reset, etc. See example script in Figure 7. (next page).

B) !	Eile Edit	⊻iew Ir	nsert F <u>o</u> rmat <u>T</u> o	ols <u>D</u> ata <u>W</u> in	dow <u>H</u> elp		E	
	A	В	C	D	E	F	G	Н
1		PTEC	test procedure	<u>v1.1</u>				
3		sid	name	read	format	test	write	sleep
4		1	Start Fan	C = 1	1.000		4:46:85:9:8 = C	
5		2	FanSpd->65%	A = 3.75			1:32:85:4:8 = A	
6		3	ClgVlv->0%	C = 0	logic	al	1:79:85:4:8 = C	
7		4	HtgVIv->0%		cond	ition	1:80:85:4:8 = C	30
8		5	HtgVIv->100%	C = 100		_ ノ	1:80:85:4:8 = C	
9		6	SupT (0s)	B = 0:15:85	##.#			30
10		7	SupT (+10s)	A = 0:15:85	##.#			
11		8	*Heating*	C = 5		A>B+C		
12		9	ClgVlv->0%	C = 0			1:79:85:4:8 = C	
13		10	HtgVIv->0%				1:80:85:4:8 = C	10
14		11	Clg->100%	C = 100			1:79:85:4:8 = C	1
15		12	SupT (0s)	B = 0:15:85	## #		-	60
6		13	SupT (+10s)	A = 0 5:85	##.#			

Figure 7. Example XLS Script

4.2 Address

Once creating XLS script, the BACnet Browser uses a simple address representation. It is denoted by numbers separated by single colons.

Address = a:b:c:d:e, where a,b,c,d and e are numbers

The first three numbers **a:b:c** are associated with "read" command and additional requirement of **d:e** in order to correctly define a "write" command.

Address have different representation based on the object types. It varies depending if it is Analog Input/Output, Analog Value, Binary Input/Output or Binary Value.

Object Type	Address "a"
Analog Input	0
Analog Output	1
Analog Value	2
Binary Input	3
Binary Output	4
Binary Value	5

Table.1 lists the value of "**a**" required to define the main Object types.

Table 1. Object Type Address "a"

The second position in signal address "b" indicates the object instance number.

Object Instance	Address "a:b"
Analog Input 4	0:4
Analog Output 1	1:1
Analog Value 2	2:2
Binary Input 4	3:4
Binary Output 1	4:1
Binary Value 11	5:11

Table 2. Object Instance Address "b"

The third number in the BACnet address "**c**" indicates specific object property. See various objects in Figure 8. For example, the "present value" has number "**85**".

File Help			· Parata Antonia
🗈 📾 Network 702		CHARMIC	
E-E Network 703		EMENS	
Device 2098178 "Site01'AS02"	6	acked transitions	Jima ma ma
- 🐏 Analog Input 1			
- 🕑 Analog Input 2	17	notification class	31
- 🐼 Analog Input 3	22	cov increment	0.200000
- 🛃 Analog Input 4	25	deadband	0.500000
- 🐼 Analog Input 5	28	description	"Fan Speed"
- 🐼 Analog Input 6	35	event enable	{true,true}
- 🕑 Analog Input 7	36	event state	fault
- 🛃 Analog Input 8	45	high limit	100.000000
- 🕑 Analog Input 9	52	limit enable	{true.true}
- 🛃 Analog Input 10	59	low limit	0.000000
- 🐼 Analog Input 11	72	notify type	0
- 🕑 Analog Input 12	75	object identifier	Apalog Output 1
- 🐼 Analog Input 13	73	object name	"B'AS'AHI 114'EVE'ESD"
- 🕑 Analog Input 14	70	object hune	Apples Output
- 🛃 Analog Input 15	79	object type	Analog Output
Analog Input 16	81	out or service	FALSE
- 🕑 Analog Input 17	85	present value	0.000000
Analog Output 1	87	priority array	{Null, Null, Null
Analog Output 2	103	reliability	configuration-error
Analog Output 3	104	relinguish default	0.000000
Analog Output 4	106	resolution	0.100000
Analog Output 5	111	status flans	(true true falce falce)
A unalog Output 6	T		<u>)</u>

Figure 8. Property Code "c"

There is also an alternative method to address an objects present value. It can be done directly by assigning object name to the address, example

Address = B'GBM'MonthlyBiomassTarget

In order to 'write' to an object it is important to set the "Tag" and "Priority" parameters, these are indicated by "**d**" and "**e**", respectively. The priority parameter is particularly important if the object has a priority array property. To access to priority array in the BACnet Browser double click on object "87 - priority array".



Priority is crucial for output operation; it allows multiple control inputs to be defined for an output, with the priority mechanism determining which input determines the output value. BACnet Browser specifies optional object properties to support command prioritization. The Priority Array property consists of 16 entries, corresponding to BACnet's 16 command priorities (Figure 9.). A value with a priority of 16 possesses the lowest priority in the array and is overridden by all other values (e.g. scheduler, safety function). Thus giving any action lowest priority, the action will continuously proceeded until it is not released. For example, it can be fire operation and as long as it is not released any other action will not be undertaken. Example full BACnet addresses is shown in Table 3.

Signal	a	b	с	d	e	full address a:b:c:d:e
Analog Input 4	0	4	4			0:4:4
Analog Output 1	1	1	3	0	8	1:1:3:0:8
Analog Value 2	2	2	2			2:2:2
Binary Input 4	3	4	3			3:4:3
Binary Output 1	4	1	1	9	3	4:1:1:9:3
Binary Value 11	5	11	1			5:11:1

Table 3. Example Addresses

4.3 Logical Conditions

Logical condition have crucial role while carrying out BACnet tests. Basic mathematical operations are incorporated to evaluate logic conditions within test and based on obtained result to proceed Test Sequencer operations. The detail Test Sequencer Operation is described in Section 4.5 "Load Test". Example test conditions for Test Sequencer operations are as follows:

A = B	check if variable "A" ad "B" are equal, where B incorporates tolerance factor C, thus effectively $A = B (\pm C)$
A > B + C	check if "A" is greater then sum of "B" and "C"
A < B - C	check if "A" is less then subtraction of "C" from "B"
G1 = A	check if variable "G1" ad "A" are equal, where A incorporates tolerance factor C, thus effectively $G1 = A (\pm C)$
G2 = B	check if variable "G2" ad "B" are equal, where B incorporates tolerance factor C, thus effectively $G2 = B (\pm C)$

4.4 Export to XML

Once the test is created using MS Excel, it can be exported into an XML file and loaded to Test Sequencer. To do that left click on spread sheet, go to "XML" and "Export".

10	HtgVIv->0%		-				1:80:85:4:8 = C		60
11	HtgVIv->100%	C = 100	¥	Cu <u>t</u>		1:80:85:4:8 = C			
12	SupT (0s)	B = 0:15:85	Ea	Сору					60
13	SupT (+10s)	A = 0:15:85	1	Pacte					
14	*Heating*	C = 5			A>E	3+C			
15	ClgVIv->0%	C = 0		Paste Special			1:79:85:4:8 = C		
16	HtgVIv->0%			Insert •			1:80:85:4:8 = C		30
17	Clg->100%	C = 100		Delete •			1:79:85:4:8 = C		1
18	SupT (0s)	B = 0:15:85		Clear Contents					60
19	SupT (+10s)	A = 0:15:85							
20	*Cooling*	C = 5		List	A <f< td=""><td>R-C</td><td></td><td>-</td><td></td></f<>	R-C		-	
21	Fan->Auto	C = 0		XML ►		Imp	ort		
22	FanSpd->Auto		<u></u>	Insert Comment	0E	Exp	ort		
23	ClgVIv->Auto			Format Cells	<.	Refr	esh XML Data	-	
24	HtgVIv->Auto			Lonnac celis	Eense I			-	
25	RmT	A = 0:4:85		Pick From Drop-down List		ZML	Source		
26	SupT	A = 0:15:85	2	Hyperlink	₩.	XML	Map Properties		
27	RmH	A = 0:126:85	5	Look Up	品	Edit Query			
28	CO2	A = 0:125:85				UM	Francisco Desdes	-	
29	Resume					SIME	Expansion Packs	he	

Figure10. Export to XML

You will be asked to specify location where you want to save your XML file. Specify location and confirm choice by clicking "Export" button.

4.5 Load Test

Load any test stored in XML format to Test Sequencer. Right click on "File", expand list, go to "Load" and "Test Configuration" (Figure 11.) Next, go to directory with XML file location and load test (Figure 12).

BACnet Browser		
lle Help		
Settings Send 'Who-Is'	SIEMENS	
Find Device		
Export		
Run Server		
Load Dialog Configuratio	1	
Test Sequencer Test Configuration		
Exit		
		<u>.</u>
		1



Figure 12. Load XML file

Figure 11. Load Test

Once test is loaded, highlight all devices which you want to be tested, then left click on "File" and go to "Test Sequencer".



Figure 13 Launch Test Sequencer

Next, BACnet Browser will navigate you to BACnet Browser – Test Sequencer. At this stage, the test is ready to be run. As test progresses, thus results can be followed from the beginning till the end. On the left had side of Test Sequencer Window are devices taking part in test are displayed, while the top bar contains information with all action which are going to be taken during particular test. Actions are executed from left to right, column by column and row by row. Only actions designed previously in XLS file

(Figure 14) and loaded can be carried out. Moreover, each test can be stopped any time and reactivated by pressing RUN/STOP button, see Test Sequencer (Figure 14).

ClgVlv->Auto	HtgVIv->Auto	23.4 23.4 23.4	SupT 28.3 26.0
ClgVlv->Auto OK OK	HtgVlv->Auto	23.4 23.4	SupT 28.3 26.0
ОК ОК ОК	ОК ОК ОК	23.4 23.4	28.3 26.0
0K 0K 0K	0K 0K	23.4 23.4	28.3 26.0
ОК ОК ОК	ok ok	23.4 23.4	28.3 26.0
ok ok ok	ок ок ок	23.4 23.4	28.3 26.0
ok ok	ok Ok	23.4	26.0
OK	OK	00 4	
	100000	23.4	29.7
OK	OK	23.4	29.7
OK	OK	23.4	28.8
OK	OK	23.4	29.1
OK	OK	23.4	28.5
OK	OK	23.4	33.0
OK	OK	23.4	30.8
OK	OK	23.4	29.1
	ок ок ок ок	OK OK OK OK OK OK	OK OK 23.4 OK OK 23.4

Test Sequencer executes steps based on specification provided in XML file. Steps are carried out from left to right, row after row. Once test is started, the Test Sequencer reads values specified in "read" column and assign them to one of the variable (A, B, C, X, Y, Z, G1, G2). Next, it verifies the format type, if specified by designer and proceed to logical operation. During the logical operation "test", the logical conditions are evaluated. If logical condition is failed, Test Sequencer ignores "write" command, goes straight to sleep operation and executes it. However, if logical test is passed, Test Sequencer executes "write" command. Once "write" command is carried out, Test Sequencer proceeds sleep operation. It is only applicable if there is any delay specified. Once finish "sleep" command, Test Sequencer terminates its operation. The Test sequencer operation is summarized in Figure 14.





4.6 Export Test

When test is finished, results can be analysed, exported and saved in CSV format.

🚯 BACnet Browser - Test	Sequencer									
Loaded Test	PTEC test procedure v1.1				Run					
Name	Clg->100%	SupT (0s)	SupT (+10s)	*Cooling*	Fan->Auto	FanSpd->Aut	ClgVlv->Auto	HtgVlv->Auto	RmT	SupT
Device 1048577 "MS01"								1	0	
Device 2098177 "Site01'AS01"								1		
Device 7002 "BNR02"										
Device 9010 "TEST10"	ОК	28.3	28.3	Fail	OK	OK	OK	OK	23.4	28.3
Device 9011 "TEST11"	ОК	26.0	26.0	Fail	ОК	OK	ОК	OK	23.4	26.0
Device 9027 "TEST27"	ок	29.7	29.7	Fail	ОК	OK	ОК	OK	23.4	29.7
Device 9028 "TEST28"	OK	29.7	29.7	Fail	OK	OK	OK	OK	23.4	29.7
Device 9029 "TEST29"	ОК	28.8	28.8	Fail	ОК	OK	OK	OK	23.4	28.8
Device 9030 "TEST30"	ОК	28.8	28.8	Fail	ОК	OK	ОК	OK	23.4	29.1
Device 9031 "TEST31"	ОК	28.3	28.5	Fail	ОК	OK	OK	OK	23.4	28.5
Device 9032 "TEST32"	ок	33.0	33.0	Fail	ОК	OK	OK	OK	23.4	33.0
Device 9033 "TEST33"	OK	30.8	30.8	Fail	OK	OK	OK	OK	23.4	30.8
Device 9034 "TEST34"	OK	29.1	29.1	Fail	ОК	OK	ОК	OK	23.4	29.1
Device 2098178 "Site01'AS02"										1



Figure 6. Test Sequencer Export