BAC/S1.5.1 Building Automation Controller Function Description

GPG BUILDI	NG AUTOMATION				
DocType:	Function Description	DocNr.	9AKK107046A7725	Revision:	С
Department	: BA Engineering	Author:	Engineering Team BA/DESTO		
System:	i-bus KNX	Product:	BAC/S1.5.1		
Page:	1/30	Date:	19. Dez. 2018		



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This document serves the sole purpose of providing additional, technical information and possible application and use cases for the contained products and solutions. It **does not** replace the necessary technical documentation required for planning, installation and commissioning of the product. Technical details are subject to change without notice.

Despite checking that the contents of this document are consistent with the current versions of the related hard and software of the products mentioned within, deviations cannot be completely excluded. We therefore assume no liability for correctness. Necessary corrections will be introduced as and when new versions of the document are generated.

Objectives of the document

This document describes the use of the BAC/S1.5.1 Building Automation Controller KNX and is intended for system integrators who program it. In addition, the information contained also supports the planning of KNX systems in which this controller is used.

Prerequisites for understanding this document are basic knowledge of KNX / ETS and IEC 61131-3 / Codesys programming. For more information see chapter 4.1 Support and training.

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1 Introduction

1.1 System Overview

The powerful BAC/S1.5.1 Building Automation Controller has a well-known and standardized programming and is seamlessly integrated into room automation. This reduces your commissioning and maintenance efforts and costs.



Figure 1: Schematic product overview

The BAC/S1.5.1 Building Automation Controller with its modular inputs and outputs is designed for the automation of central systems with many signals and actuators. For example for the automation of Air Handling Units (AHU). In contrast, ABB offers a specially designed product portfolio for distributed room automation with KNX sensors, actuators and gateways. These room devices are seamlessly connected to the BAC/S1.5.1 Building Automation Controller via KNX.

1.2 Product Benefits

ABB offers a complete and consistent product range based on open and globally standardized technologies, ranging from Building Automation Controllers to Room Automation Products.

Freely programmable

- Powerful programming based on the standardized IEC 61131-3 programming languages in the ABB Automation Builder.
- Based on the established Codesys software. Thus, easy reuse of your existing Codesys based projects
- Easy use of third-party automation software libraries based on IEC 61131-3

KNX

• Seamless solution from Building Automation Controllers to Room Automation. No gateways and integration effort required.

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- Fully integrated in KNX and ETS. The controller is a certified KNX device with group objects in ETS and a physical KNX address
- Direct data exchange between the Engineering Software ABB Automation Builder and ETS

1.3 Product Portfolio

The product family consists of the BAC/S1.5.1 Building Automation Controller KNX as well as 6 different input and output modules and the Engineering Software. For more information, see the linked product detail websites.

Product	Order code
BAC/S1.5.1 Building Automation Controller, KNX	2CDG120062R0011
BCM/S16.2.0.1 BAC-Module, 16DI, 100-240V	2CDG120063R0011
BCM/S16.1.1 BAC-Module, 16DI/DO, 24V, 0.5A	2CDG120064R0011
BCM/S16.1.3.1 BAC-Module, 8DI 24V + 8DO Relay	2CDG120065R0011
BCM/S8.0.2.1 BAC-Module, 8DO, 230V, 0.3A	2CDG120066R0011
BCM/S6.5.5.1 BAC-Module, 4AI + 2AO, U/I	2CDG120067R0011
BCM/S2.6.0.1 BAC-Mod. 2AI, Temperature	2CDG120068R0011
BCE/Z1.1 BAC Engineering Software	2CDG120069R0011

The BAC/S1.5.1 Building Automation Controller can be extended with up to 10 input and output modules. The controller has a display for operation and has 2 Ethernet network interfaces. In addition to KNX with 1000 KNX group objects, the Controller also supports Modbus (RS-232/485 interface and TCP) and CAN protocols. He also include a web server with a freely configurable web interface for displaying and operating the system.

The products are based on the proven ABB AC500 product family of Industrial Automation and have been prepared for the requirements of Building Automation. For example, the BAC/S1.5.1 Building Automation Controller is ready for operation when delivered and can be addressed via KNX.

The product family can also be complemented by other products from the ABB Industrial Automation product portfolio of Programmable Logic Controllers (PLC) type AC500 and AC500-eCo. So the complete portfolio of input and output modules are compatible with the BAC/S1.5.1 Building Automation Controller. On the other hand, all ABB AC500 and AC500-eCo PLC CPU modules version V3 can be extended by KNX communication with a paid KNX runtime license. This offers a wide choice of different performance classes of Controllers. But this is associated with an increased effort during commissioning. For example, the KNX communication in the PLC is not active at delivery condition. For more information about the products and the sources of supply, see www.abb.com/plc

2 Basics

2.1 System Topology



Figure 2: System Topology

The BAC/S1.5.1 Building Automation Controller is a standard KNX device in which KNX communication is done via the IP network interface. It is arranged topologically on the area / main line of the KNX IP routers and communicates with them via the KNXnet/IP protocol. The controller does not have a KNX twisted pair (TP) connection.

On delivery, the network interface Ethernet 1 (upper connection) is activated with the KNX communication and the web interface.

2.2 Overview of Engineering

The BAC/S1.5.1 Building Automation Controller is programmed using two programs that work together seamlessly.

Programming and commissioning of the Building Automation Controller is done with the software **ABB Automation Builder**. This includes, among others

- Configuration of the Building Automation Controller
- Configuration of the input and output modules
- Set the IP network settings
- Creation of the automation program
- Creation of the KNX group objects
- Firmware update of the Building Automation Controller
- Download this configuration listed above into the Building Automation Controller

The subsequent linking of the Building Automation Controller with the other KNX devices takes place with the vendor independent KNX commissioning software ETS. This includes

Programming the physical KNX address of the Building Automation Controller

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- Parameterizing the KNX send conditions of the Building Automation Controller
- Linking the KNX group objects of the Building Automation Controller with KNX group addresses
- Download this KNX configuration listed above to the Building Automation Controller

The programming of the BAC/S1.5.1 Building Automation Controller and the KNX commissioning can be done by different people at different times. Both programs carry out their own download of their respective configurations to the Building Automation Controller. The only data exchange between the two programs are the details about the KNX group objects defined in the ABB Automation Builder. This is done flexible via a configuration file.



Figure 3: Data exchange

This has the further advantage that changes are possible at any time without the respective other program. For example, the KNX group objects associated with the BAC/S1.5.1 Building Automation Controller can be changed without the ABB Automation Builder being necessary. On the other hand, the automation program can also be changed without the ETS. As long as no changes have been made to the KNX group objects.

The following chapter describes in detail the individual steps of commissioning the Building Automation Controller.

Both programs are fee-based. There are demo versions offered.

Title:

3 Commissioning

3.1 Installation of the Engineering Software

3.1.1 Automation Builder

Download the latest ABB Automation Builder from the product website of the BAC/S1.5.1 Building Automation Controller. You will find these at

www.abb.com/knx

On this website, an Automation Builder installation program is offered for download which is customized for Building Automation. It only contains the program packages required for programming the BAC/S1.5.1 Building Automation Controller.

ABB Automation Builder 2.1.2 Build 644 - Selection Page	
Automation Builder Engineering Productivity	ABB
Install Software Packages for:	Description Release Notes Packages
Professional Version Control Professional Version Professional Versional Versional Version Professional Versional Versiona Professional Versional VersioNersional Versional Versional Ver	 KNX Protocol for AC500 V3 The use of the KNX IP protocol on an AC500 V3 CPU needs in addition a runtime license (1SAP195800R0101, PS5804-KNX) This software package contains the following main components and features: Configuration of KNX protocol and objects Export of resulting device configuration for ETS5 DCA (-> separate download from ABB, KNX.org)
Install also previous product versions	
Automation Builder 2.0	
Not Installed	Previous Download and install Cancel

Figure 4: Installation of Automation Builder for Building Automation

The optional program packages shown in Figure 4 can be selected as needed.

Please use Automation Builder version 2.2.0 or later. As of version 2.1.2, KNX is supported in the Automation Builder. However, this release contains an outdated implementation of the status flags and ValueRead function, which is not compatible with the following versions. The difference is described in the following chapters.

The ABB Automation Builder requires the license **BCE/Z1.1 BAC Engineering Software**. The ABB Automation Builder also offers a demo mode in which the functionality can be fully tested for 30 days.

With this ABB Automation Builder installation and license, in addition to the BAC/S1.5.1 Building Automation Controller, you can also program other ABB AC500 and AC500-eCo Version V3 PLCs.

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If you need advanced features, you can also use the Standard Automation Builder to program the BAC/S1.5.1 Building Automation Controller with the **Standard** or **Premium** Automation Builder license. This requires the Automation Builder program package **KNX** to be installed. For more information see www.abb.com/plc

3.1.2 ETS

Download the latest ETS version from www.knx.org. You need the version ETS 5.6.5 or newer.

The integration of the ABB Automation Builder into the ETS is done by the Device Configuration App (DCA) **ABB Automation Builder**. Please download this DCA from the ETS app shop at www.knx.org. Install them as shown in Figure 5 by clicking on **Apps** in the lower right corner of the ETS and clicking on the + icon to add.

55™							
Dersicht Bus Kataloge Einstell	ngen					ĸ	NX
ojekte Archiv ETS Inside		KNX News	5		Neue KNX Produk	te	
; ame • Status Benutzer Arbeitsbereich Datum •	Suchen 🔎	KNX Journal 2 17.09.2018 The KNX Journ main topics: - KNX RF the N	2-2018 nal 2-20 New Era	now available D18 is now available, with as	Busch-SmartTouch® Busch - Jaeger Elektro GmbH ((Sermany)	< >
		- KNX Secure - KNX Award	App	s + c		11 aktiv / 20) installiert
		You can dow www.knx.org		Name	Hersteller	Version	Lizenz
		KNX-Journal	~	ABB AC/S Konfiguration App	ABB	0.1.0.3	2
		www.knx.org		BB Automation Builder	ABB	1.0.0.0	2
		KNX-Journal, Journal-2-20	~	BJE CommissioningTool	Busch-Jaeger Elektro	5.0.56.0	G.
			v 1	BJE KNX Bus Update	Busch-Jaeger Elektro	1.0.37.0	G.
		KNX IoT sho Intelligent B		Compatibility Mode App	KNX Association	5.6.1109.31179	G.
		16.09.2018 KNX Nationa		DcaCarel	Carel	0.5.2017.103	G.
		have particip KNX is the le	•	Device Compare	KNX Association	5.6.1109.31179	•
		Joint Booth,		Device Templates	KNX Association	5.6.1109.31179	•
		solutions and	6	EIBlib/IP	KNX Association	5.6.1109.31179	•
		their KNX Me		Extended Copy	KNX Association	5.6.1109.31179	•
		future for KN	2	IPPDataExchange	Busch Jaeger Elektro	4.0.194.0	
		seminar abor was held, wit	₹.	KNXMCM BAline Studio Excha	nge WAREMA Renkhoff SE	1.4.4.0	ū.
		manufacture solutions. Th		Labels	KNX Association	5.6.1109.31179	•
		(KNX Associa Solutions), w		MDT Glastaster II Smart	MDT technologies GmbH	2.2.0.0	G.
		community a milestones ()		Project Tracing	KNX Association	5.6.1109.31179	•
		Association i Chinese mark	•	Replace Device	KNX Associati	5.6.1109.31179	•
			~	SIEMENS Adressen mit ID	Siemens	171.0	ū.
		KNX Summe	~ 1	SIEMENS KNX2S7 Export	Siemens		G.
		KNX Nationa	E	Split and Merge	KNX Association	5.6.1	0
		various KNX	11	Web service exporter	KNX Association	0.0.7	•

Figure 5: Installation of the DCA in ETS

To install and run DCAs, you need the ETS license **Lite** or **Professional**. DCAs are not available in the ETS5 demo version.

Import the ETS application of the BAC/S1.5.1 Building Automation Controller into the ETS catalog. Either via the online function of the ETS catalog or as a download of the .knxprod file from www.abb.de/knx

3.2 Programming the Controller

3.2.1 Automation Builder Project

Download the Automation Builder BAC/S1.5.1 Template Project matching the ABB Automation Builder version from the product website of the Controller at www.abb.com/knx.

In this Template Project the BAC/S1.5.1 Building Automation Controller is already preconfigured. This project is as well preinstalled at the factory on the Controller so that the Controller is ready for use and can be addressed via KNX.

If you start with your own empty Automation Builder Project, you must select the correct Controller and insert the KNX communication interface by right click **add object**, either to the network interface 1 (**ETH1**) or network interface 2 (**ETH2**).



Figure 6: KNX Group Objects at network interface ETH1

3.2.2 Address Controller

In the delivery state, the Controller has the following IP network settings at the network interface 1

IP Address:	192.168.0.10
Subnet Mask:	255.255.255.0

You can change the IP network settings via the display of the controller or via the ABB Automation Builder:

Display

- 1. Press the CFG button
- 2. Confirm the display prompt **1PEth1** with the **OK** button
- 3. Press the **CFG** button to select whether to set a static IP address (**static**), reset (**reset**) or automatic (**DHCP**) IP configuration. Confirm with the **OK** button.
- For a static IP address, the IP address and the subnet mask are displayed one after the other by pressing the CFG button. The addresses are displayed block by block in the display as follows
 IP Address: A1.A2.A3.A4

Subnet mask: n1.n2.n3.n4

You can change these with the arrow keys and save them with the **OK** button.

With the **ESC** button you can leave the menu at any time without saving.

For detailed instructions, see the ABB Automation Builder Help.

ABB Automation Builder

You can also change the network settings in the Automation Builder using the menu item **Tools** \rightarrow **IP-Configuration**. Perform a scan on the network, and then select the Controller. Using **Send Configuration**, the network settings can be sent to the controller. To do this, the Controller must be stopped by pressing the **RUN** button on the controller until the display prompt **STOP**.

IP-Konfiguration 🗙]						-
Abort scan							
MAC address	Device name	Position	Serial number	Device ID	Current IP Address	Configured IP Address	Auth. supp
± 00-24-59-0D-07-42	PM5630-2ETH	ETH1	00000132	0x00	192.168.7.222	192.168.7.222	no
PM5630-2ETH New configuration	[SN=000001:	32, ID=0)	k 00]				,
DHCP							
IP address 19	2.168.7	. 222			Blink-timeout (s)	10	
Subnet mask 25	5 . 255 . 255	. 0	Send Configuration		Blink-interval (s):	1	
Standard gateway 0	. 0 . 0	. 0	22.1.2 Contrigutation		E	link	
Link mode Auto		•					

Figure 7: IP device scan and configuration

Once the desired IP network setting has been set for the BAC/S1.5.1 Building Automation Controller, this network address must also be specified in the Automation Builder Project. To do this, right click on the Controller and select **Communication Settings**.



Figure 8: Communication Settings

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Enter the IP address there or select the Controller found in the network by clicking on the ... button.

Communication Settings for 'BAC_S_1_5_1_Buildi							
IP Address		192 .	168 .	0	. 10		
Use advanced settings							
A	dvanced Set	tings					
(I)			ОК		Car	ncel	

Figure 9: Set network settings

3.2.3 Configure input and output modules

Add the input and output modules connected to the BAC/S1.5.1 Building Automation Controller via the **Add object** function to the **IO_Bus** of the Controller.



Figure 10: Add input / output module

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BAC/S1.5.1 Building Automation Controller 9AKK107046A7725 C 11/30 The selection dialog of all available input and output modules opens.

Add object below : IO_Bus					x
Object path: BAC_S_1_5_1_Building_Automation_Controller Object name:	IO_Bus				
Categories •	Search obje	ct name			
<mark>⊞</mark> ⊷ S500 eCo I/O modules	Name	Short Description	Version	Order Number	
B. Solu I/O modules Scripting	 Al561 Al562 Al563 AO561 AX561 DC561 DC562 DI561 DI572 DO561 DO562 DO561 DO562 DO562 DO562 	4AI, U/I, 12bit+sign 2AI, RTD, 15bit+sign 4AI, Thermocouple, 15bit+sign 2AO, U/I, 12bit 4AI/2AO, U/I, 12bit 16DC, 24VDC 16DC, 24VDC 8DI, 24VDC 8DI, 24VDC 8DI, 115-230VAC 16DI, 100-240VAC 8DO-T, 24VDC 16DO-T, 24VDC	3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0 3.1.0.0	1TNE968902R1101 1TNE968902R1102 1TNE968902R1103 1TNE968902R1201 1TNE968902R1201 1TNE968902R2001 1SAP231900R0000 1TNE968902R2102 1TNE968902R2103 1SAP230500R0000 1TNE968902R2201 1SAP230900R0000	E
Close this dialog after each transaction	Display	all versions			
Reset filter		A	dd object	Close	

Figure 11: Select input / output modules

Select the concerned modules. The BCM/Sx.x.x.x BAC-Modules for Building Automation contain the following module names. You can find these using the search function.

Product	Order Number	Module Name
BCM/S16.2.0.1 BAC-Module, 16DI, 100-240V	2CDG120063R0011	DI572
BCM/S16.1.1 BAC-Module, 16DI/DO, 24V, 0.5A	2CDG120064R0011	DC562
BCM/S16.1.3.1 BAC-Module, 8DI 24V + 8DO Relay	2CDG120065R0011	DX571
BCM/S8.0.2.1 BAC-Module, 8DO, 230V, 0.3A	2CDG120066R0011	DO572
BCM/S6.5.5.1 BAC-Module, 4AI + 2AO, U/I	2CDG120067R0011	AX561
BCM/S2.6.0.1 BAC-Module, 2AI, Temperature	2CDG120068R0011	AI562

The order of the modules in the tree view of the Automation Builder must be in the order in which they are connected to the Controller.

3.2.4 Create KNX Group Objects

The data exchange with the KNX bus is done via KNX Group Objects.

Create the KNX Group Objects required for your application in the parameters of the **KNX** interface below the network interface 1 (**ETH1**) on the parameter page **General**.

Note

After Reboot/Restart of the PM56xx-2ETH the first configured KNX group object, connected with a group address, is sent to the KNX-Bus with its default value.

To avoid unplanned reactions at the KNX network, the first configured KNX group object has to be a dummy object and must be connected to an unused group address in the KNX network.



Figure 12: Open the KNX settings

With the **Add** button you can create a new KNX Group Object with the following properties as shown in Figure 13:

Channel Number

The number of the KNX Group Object. This must be unique within the Controller. It is displayed in the ETS and influences the display order in the ETS and the Automation Builder.

Group Object Name

The name of the KNX Group Object. It is freely selectable and is displayed in the ETS under the field name.

Туре

Specification of the KNX data point type (DPT) of the Group Object. This determines the memory size, scaling and unit. For further information see the KNX Standard.

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Group Object Function

The name of the function of the Group Object. It is freely selectable and is displayed in the ETS under the field Function.

Input / Output

Selection of the communication direction.

Input means that the controller receives values from the KNX bus.

Output means that the controller sends values to the KNX bus.

Based on this selection, the flags of the KNX Group Object are set accordingly in the ETS.

KNX X								
General	🕂 Add 📝 Edit 🗙 Delete Export to ETS Import CSV Export CSV							
KNY I/O Managina	Channel Number	Group O	bject Name	Group Object Function	Туре	DPT		
KNX I/O Mapping	1	Room 233	Presence Detector A	Presence	Input	DPT 1.*		
I/O mapping list	2	Room 233	Presence Detector B	Presence	Input	DPT 1.*		
	3	Room 233	Presence	Presence Analysis	Output	DPT 1.*		
Status	_							
Information	Communication object							
	Channel Number 1							
	Group Object Name Room 233 Presence Detector A							
	Type DPT 1.* Bool 💌							
	Group Obje	ect Function	Presence					
			Input O (Dutput	ОК	Cancel		
		_	_		_			

Figure 13: Creation of the KNX Group Objects

You can use the **Export CSV...** button in the menu bar to display the list of KNX Group Objects in a spreadsheet program such as Excel and edit and extend it flexibly. Then you can import them again via **Import CSV**.

After you have created all the required KNX Group Objects, export them using the **Export to ETS** button. This exported file contains the configuration of the KNX Group Objects of the BAC/S1.5.1 Building Automation Controller and is imported by ETS for linking to other KNX devices. If you have not yet created project information under **Project** \rightarrow **Project Information**, the default values will be used during the export.

To use these KNX Group Objects in your automation program, you must assign them with IEC61131-3 variables. This additional abstraction layer of an additional variable allows you to create modular automation programs that are independent of the used bus system or input / output modules.

The assignment is possible either via the parameter page **KNX I/O Mapping** or **I/O mapping list**. Both pages offer the same function in different representation.

General	Find		Filter Show all	-				
KNX I/O Mapping	Variable	Mapping	Channel	Address	Туре	Default Value	Unit	De
nine for hopping	🎋 KnxPrgLed	*	Program LED Status	%IX0.0	BOOL			Pro
I/O mapping list	KnxPrgBtn	*	Program Button	%QX0.0	BOOL			Pro
	i *>		1 - Room 233 Presence Detector A - Presence	%IB1			DPT 1.*	
itatus	🛱 - 🦄		Statusbyte	%IB1	BYTE			
	*		UpdateFlag	%IX1.3	BOOL			
nformation			ValueChanged	%IX1.4	BOOL			
			ValueValid	%IX1.5	BOOL			
	PresenceA	**	Value	%IX2.0	BOOL			
	🚔 🍫		2 - Room 233 Presence Detector B - Presence	%IB3			DPT 1.*	
	🚔 🍫		Statusbyte	%IB3	BYTE			
	*		UpdateFlag	%IX3.3	BOOL			
	¥ø		ValueChanged	%IX3.4	BOOL			
	· · · · · · · · · · · · · · · · ·		ValueValid	%IX3.5	BOOL			
	PresenceB	**	Value	%IX4.0	BOOL			
	i		3 - Room 233 Presence - Presence Analysis	%QB1			DPT 1.*	
	🚔 🍢		Trigger/Disable Cyclic,send on change	%QB1	BYTE			Cor
	*		Trigger Output	%QX1.0	BOOL			Fals
	* @		Disable Output	%QX1.1	BOOL			True
	PresenceResult	***	Value	%QX2.0	BOOL			

Figure 14: Assignment of the IEC 61131-3 variables to the KNX Group Objects

On the **KNX I/O Mapping** page, the KNX variables are shown hierarchically. Each KNX Group Object consists of several channels with additional information. These differ depending on whether it is an input or an output.

The table is structured as follows:

Variable

Enter the name of the IEC 61131-3 variable that you want to assign to this channel (KNX Group Object).

Mapping

Shows if the channel is already linked

Channel

Name oft he Channel

Address

The memory address under which the information is stored in the memory of the Controller. Inputs start with %I and outputs start with %Q.

Тур

Specification of the IEC 61131-3 variable type

Default Value

The value used after starting the controller. At a KNX Group Object input, this value is used by the automation program until a value has been received from the KNX bus.

At a KNX Group Object output, this value is sent to the bus when the controller is started.

Unit

Specification of the KNX data point type (DPT)

Description

Note text

A KNX Group Object input consists of the following channels:

Channel name: Object Number + Object Name + Object Function

UpdateFlag

This status flag is set to the value true as soon as a new KNX telegram has been received. Even if the value of the telegram does not differ from the previous one.

ValueChanged

This status flag is set to the value true as soon as a new KNX telegram has been received and the value differs from the previous one.

ValueValid

This status flag is set to the value true as soon as a KNX telegram has been received for the first time after the controller has been started.

Value

The current value of the KNX Group Object received from the KNX bus.

Channel name: "Control" + Object Number + Object Name + Object Function

Reset status flags

When this flag is set from false to true by the automation program then the abovementioned status flags of the KNX Group Object are reset to the value false.

Set read flag

When this flag is set from false to true by the automation program, a ValueRead telegram is sent to the KNX bus. This causes the KNX remote device to send back its current value.

Attention: This information refers to Automation Builder version 2.2.0 or later. In version 2.1.2 there are no "Control" channels. **Reset Status flags** and **Set read flags** must be called there by a function from the automation program referring the KNX Group Object number.

A KNX Group Object output consists of the following channels:

Channel name: Object Number + Object Name + Object Function

Trigger Output

When this flag is set from false to true by the automation program, the current value is sent immediately to the KNX bus.

The sending conditions that are may been activated in the ETS (**send on change** and **cyclic sending**) will be restarted

Disable Output

As long this flag is set to true by the automation program, the sending conditions **send on change** and **cyclic sending** in the ETS are deactivated.

Value

The current value of the KNX Group Object that is sent to the KNX bus.

The permanently defined channels **Program Button** and **Program LED Status** represent the functions to switch the controller into the KNX programming mode with which the physical KNX address can be programmed. In the Automation Builder template project these are linked to the corresponding function as well as to the variables of the **VisuPhysAdr** web page and the display of the controller.



Figure 15: Webpage for the KNX programming button

Attention: If you want to control the KNX programming mode via your automation program or web user interface then use from ABB Automation Builder Version 2.2.0 or later the function call instead of the IEC 61131-3 variables **Program Button** and **Program LED Status**. Otherwise these variables are continuously overridden by the display of the Controller.

3.2.5 Create Automation Program

The KNX variables defined on the **KNX I/O Mapping** page are available program-wide under **IoCon-fig_Globals_Mapping**.

Various programming languages are available for creating your automation program. An empty program **PLC_PRG (PRG)** for the structured text programming language has already been created in the Automation Builder template project.



Figure 16: Example program in textual programming language

By right-clicking on the entry **Application** in the tree with **Add object**, you can create new programs and software functions. To do this, select the object **POU** in the window that opens in Figure 17 and select afterwards the desired programming language.

Add object below : Application Object path: BAC_S_1_5_1_Building_Automation_Con Object name: POU	troller\Plc Logic\Application			x
Categories -	Search object name			Q
Generic objects IEC61131-3 Other Scripting Visualization	Name Mam configuration CheckConfiguration Data Sources Manager DUT Global Variable List Image Pool Interface Network Variable List (Receiver) Persistent Variable List (Sender) Persistent Variables POU POU for implicit checks Recipe Manager Symbol Configuration	Short Description	Version	
Close this dialog after each transaction Reset filter	Display all versions Add o	object	Close	

Figure 17: Add new programm

For example, also graphical programming languages are available such as **Function Block Diagram (FBD)**.

1 PROGRAM PLC_PRG_FBD 2 VAR 3 END_VAR 4 Image: Construction of the second	• 1
1 OR PresenceA ≥1 PresenceResult Image: Constant of the second	

Figure 18: Sample program in a graphical programming language

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To prepare the download of the configuration to the BAC/S1.5.1 Building Automation Controller, the program code must first be checked and compiled. You can find this function in the menu bar under **Build** \rightarrow **Build**. Possibly errors and warnings are displayed in the message window at the bottom.

3.2.6 Download the automation program

Connect to the BAC/S1.5.1 Building Automation Controller via the function in the menu bar **Online** \rightarrow Login. This requires an IP connection between the computer and the Controller.

The ABB Automation Builder recognizes that your Automation Builder project differs from the configuration on the controller and asks if you want to download your current project to the controller. Confirm this with **yes**. Depending on the extent of the change, this can optionally be done without stopping the automation program.

So that the Controller can use this configuration also after a restart it must be saved in the controller's permanent memory. To do this, execute the function **Online** \rightarrow **Create boot application**. If this step is not performed, the last configuration saved by this function will be used when the controller is restarted.

Start the controller in run mode. Either via the menu bar **Debug** \rightarrow **Start** or the **RUN** button on the controller.

While you are connected to the running controller, the ABB Automation Builder displays the current values of the variables and you can override them for testing purposes. Changes to the program code are not possible.

KNX communication is only working after also the matching ETS configuration was downloaded to the BAC/S1.5.1 Building Automation Controller. Until then, the Controller's KNX communication is deactivated and marked with a warning symbol.



Figure 19: KNX interface not ready

However in this state the Controller can still be switched to the KNX programming mode and the physical KNX address can be programmed. Also the device info can be read by ETS.

You can use the **Online** \rightarrow **Logout** function to end the connection to the Controller. The BAC/S1.5.1 Building Automation Controller remains in run mode.

3.3 Integration of the Controller in the KNX system

3.3.1 Insert Controller

Start the ETS and insert the BAC/S1.5.1 Building Automation Controller from the ETS device catalog into your ETS project. Give the controller a physical KNX address, which places the controller topologically on the IP main line or IP area.



Figure 20: Topology in the ETS

3.3.2 Import configuration

Select the BAC/S1.5.1 Building Automation Controller and change to the DCA.



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Figure 21: Open the DCA

Click on Load Configuration and select the configuration file created in chapter 3.2.4.

The KNX Group Objects defined in the ABB Automation Builder of the BAC/S1.5.1 Building Automation Controller are then displayed in the ETS.

	Number Name	Object Function	Description	Group Address	Length	С	R	w	т	U	Data Type	Priority
■ ‡	1 Room 233 Presence Detector	A Presence			1 bit	С	-	W	Т	U	1-bit	Low
∎‡	2 Room 233 Presence Detector	8 Presence			1 bit	С	-	W	Т	U	1-bit	Low
■ ‡	3 Room 233 Presence	Presence Analysis			1 bit	С	R	-	Т	-	1-bit	Low

Figure 22: KNX Group Objects in the ETS

Connect Controller with other KNX devices 3.3.3

You can now connect these group objects of the Controller with right-click Link with to a KNX Group Address.

			×
Link With	Group A	Address	
1.0.1 BAC/S1.5 Object: 3: Roc	.1 Building A om 233 Prese	utomation Cont ence - Presence	troller Analysis
Existing	New		
Group Ad	ldress		
1/1/1			
Name			
Room 23	3 Light		
		<u>O</u> K	<u>C</u> ancel

Figure 23: Create and link Group Address

This connected KNX Group Address must then be connected in the same way to the corresponding Group Object of the other KNX device.

3.3.4 Parameters of the device

The following settings are possible in the ETS parameters of the BAC/S1.5.1 Building Automation Controller

Default Gateway

The used KNXnet/IP broadcast address. This must match the KNX system (KNX IP router). It is the default setting that is usually not changed.

Telegram rate

The maximum transmission rate of the BAC/S1.5.1 Building Automation Controller can be limited in order to prevent an excessive bus load and thus to avoid malfunction of the KNX system.

Title:

The KNX telegrams where buffered until they have been sent. New values which have been calculated by the automation program in the meantime are updating the cached values. The old cached value is discarded and not sent.

Project Information

At this point, the project information of the ABB Automation Builder project is displayed.

General Settings	Default Gateway	239.0.0.0				
Object 1 3	Telegram rate	Max. 10 telegrams per second				
	Project Title	BAC/S1.5.1 Projekt				
	Application date	2018-10-24T13:51:42.97937				
	Identifier	755751884				
	Version	1.0				
	Application state	undefined				
	Description	www.abb.com/knx				

Figure 24: ETS Parameters of the Controller

For each KNX Group Object of the Controller an **Object** entry is displayed in the device parameters. This is named after the number of the KNX Group Object.

For outputs (Controller sends to the KNX bus) the KNX transmission conditions can be set:

Communication direction

Setting of the transmission direction of the object Input (KNX to PLC): The Controller receives values from the KNX bus Output (PLC to KNX): The Controller sends values to the KNX bus

Send condition (only for outputs)

Setting whether the Controller sends a telegram to the KNX bus automatically when the object value is changed. The following options are available

No automatic sending

No automatic sending to the KNX bus. This must be done via the program code by the **Trigger Output** flag.

Send on change

Every time the object value changes, a telegram is sent to the KNX bus. No matter how minor this change is.

Send on difference (only for Group Objects which are not DPT 1.* Boolean) Every time the object value changes, this value is only sent to the KNX bus if it differs from the last sent value at least by the settable difference.

Sending difference (only if Send on difference is active)

Input of the difference by which the object value must change to be send. You can enter numbers with decimal places.

Cyclic sending (only for outputs)

Setting whether in addition the object value is sent cyclically repeatedly to the bus. This also happens if this object value has not changed. Two different value ranges for the cycle time can be specified.

Cycle time (only when Cyclic sending is active) Specification of the cycle time for the cyclic transmission. Input format hour:minute:second

1.0.1 BAC/S1.5.1 Build	ding Automation Controller > Object 1	3
General Settings	Object 1 / Room 233 Presence Detector A	
Object 1 4	Communication direction	Input (KNX to PLC)
	Object 2 / Room 233 Presence Detector B	
	Communication direction	Input (KNX to PLC)
	Object 3 / Room 233 Presence	
	Communication direction	Output (PLC to KNX)
	Send condition	\bigcirc no automatic sending \bigcirc send on change
	Cyclic sending	enable (seconds)
	Cycle time	01:00:00 hh:mm:ss
	Object 4 / Room 233 Set Point Temperature	
	Communication direction	Output (PLC to KNX)
	Send condition	send on difference 🔻
	Sending difference	1
	Cyclic sending	disable 👻
Group Objects Para	meter DCA	

Figure 25: ETS parameters of KNX Group Addresses of the Controller

Regardless of the set transmission conditions, the program code can trigger by the flag **Trigger Output** a sending of the value to the KNX bus at any time.

By activating the function **Read on Init** of the KNX Group Objects in the right ETS properties panel, the Controller sends a value read query to the connected KNX device at startup. This then responds with its current object value.

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In this properties panel you can also select the appropriate sub-data point type of the KNX Group Object. This defines the unit of the value in the KNX system. For example DPT 9.001 represents temperature in ° C.

Proper	rties	>				
Contraction Settings	Comme	(Informa				
Name						
Room 233 P	resence Dete	ctor A				
Description						
Priority						
Low		•				
Flags Commur Read Write Transmit Update Read On Data Type	nication Init					
1.* 1-bit		^				
1.001 swit	tch					
1.002 boo	lean					
1.003 ena	1.003 enable					
1.004 ram	1.004 ramp					
1.005 alarm						
1.006 bina	1.006 binary value					
Default						

Figure 26: Parameters of the KNX Group Objects

3.3.5 Download the ETS configuration to the controller

The download of the ETS configuration to the BAC/S1.5.1 Building Automation Controller is done via the ETS function **Download** in the menu bar.

Best you select in ETS the network interface of the computer as the bus interface. Thus, a fast data exchange is possible and the data is not routed via the KNX TP bus.

At the first download, the physical KNX address of the Controller is programmed. To do this, set the BAC/S1.5.1 Building Automation Controller to KNX programming mode. This can be done either via the display or the web interface of the controller.

<u>Display</u>

1. Der Controller must be in **Run** mode.

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- 2. Press the **CFG** button.
- 3. Press the button **Down Arrow** button, so that **Pbut 0** is displayed.
- 4. Press the CFG button. The display shows Pbut 1 flashing.
- 5. Confirm this with the **OK** button. The display permanently shows **Pbut 1**. The Controller is in KNX programming mode.
- 6. The Controller automatically terminates the KNX programming mode after the programming of the physical KNX address. Alternatively you can terminate the programming mode with **Pbut 0** by pressing the **CFG** button.

You can exit the menu at any time with the **ESC** button.

Attention: The activation of the KNX programming mode via the display only works with Automation Builder version 2.2.0 or newer.

Web interface

The BAC/S1.5.1 Building Automation Controller must be in **Run** mode. Open the web page of the controller by entering the IP address in a browser. In the factory settings it is http://192.168.0.10

The KNX programming mode can be activated and deactivated via the button. The red signal lamp indicates the status of the KNX programming mode.



Figure 27: Webpage of the controller

The controller automatically terminates the programming mode after programming the physical address with the ETS.

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The BAC/S1.5.1 Building Automation Controller has then besides the Automation Builder configuration also the appropriate ETS configuration and starts its KNX communication. This can be recognized by the green symbol on the KNX interface in the Automation Builder.



Figure 28: KNX Interface ready

Then download all other linked KNX devices as well as the KNX IP routers. The ETS automatically creates the filter tables of the KNX IP routers so that the KNX telegrams are routed from the KNX TP lines to the IP line of the BAC/S1.5.1 Building Automation Controller.

3.4 Make changes

Changes can be made in the ABB Automation Builder as well as in the ETS without the need for a change in the other software or the need for a new data exchange.

Only if changes are made to the KNX Group Objects in the ABB Automation Builder, a data exchange with the ETS is again necessary. Afterwards, a download is required both in the Automation Builder and in the ETS. Only when these two configurations have been downloaded again to the BAC/S1.5.1 Building Automation Controller, the KNX communication is in operation again.

The DCA detects changes to names and numbers of the KNX Group Objects when importing the configuration file in the ETS and keeps the already made settings and linked Group Addresses of these changed Group Objects.

3.5 Advanced Features

3.5.1 Activate KNX runtime license

The BAC/S1.5.1 Building Automation Controller is shipped from the factory with an installed KNX runtime license. The license document of this installed license is enclosed with the Controller in the packaging.

A KNX runtime license can be added to any compatible ABB PLC by right-clicking in Automation Builder on the Controller with the **Runtime Licensing** function.

3.5.2 Data Conversion

The KNX standard defines a big-endian byte order while the IEC 61131-3 is based on the little-endian byte order. Therefore, the controller automatically converts the data point types.

However, if you access the bits of the structured KNX data point types (DPT) for time, date and color (DPT 10.*, DPT 16.*, DPT 19.* and DPT 232.*) in your program code, you have to note the reverse byte order. Therefore, as of ABB Automation Builder version 2.2.0, corresponding function libraries are available that provide conversion functions for these data point types.

3.5.3 Battery backup

The BAC/S1.5.1 Building Automation Controller can be buffered via an optional battery, so that the data variables and the device clock are available even after a power failure. For this has the Controller has a battery compartment.

The variables must be defined as globally persistent retain variables. The controller then stores it in the battery's permanent memory which is buffered by the battery.

Alternatively, the program code may also manually store values in the flash memory.

For more information about these features, see the ABB Automation Builder Help.

3.5.4 Data storage

The memory of the BAC/S1.5.1 Building Automation Controller can be extended by a memory card. The configuration of the Controller can also store on this memory card which made an easy device replacement possible.

For more information about these features, see the ABB Automation Builder Help.

3.5.5 Device clock

The BAC/S1.5.1 Building Automation Controller has a built-in real-time clock. This can be set using the ABB Automation Builder software with the **Statistics** function or the program code.



Figure 29: Set the clock of the Controller

At a power failure the clock is buffered via the optionally available battery.

For more information about these features, see the ABB Automation Builder Help.

3.5.6 Web server with web user interface

The BAC/S1.5.1 Building Automation Controller has a web server. The web pages can be freely designed in the ABB Automation Builder. For more information, see the ABB Automation Builder Help.

3.5.7 Further communication protocols

In addition to KNX, the BAC/S1.5.1 Building Automation Controller has additional communication protocols, such as: Modbus over TCP and RS-485 as well as CAN and OPCA UA. For more information, see the ABB Automation Builder Help.

3.6 Maintenance and fault detection

3.6.1 Firmware update

The software of the BAC/S1.5.1 Building Automation Controller is updated via the **Version information** function in the ABB Automation Builder.

Devices 👻 🕂 🗙	BAC_5_1_5_1_Building_Automation_Controller X										
BAC-S_1-5-1_Template_Automation Builder_V2-1-	Communication Settings		PLC								
BAC_S_1_5_1_Building_Automation_Controller	contraction settings		Name	Firmware Type	State	Firmware Version	Available	Date	Build	Info	
= El PLC Logic	PLC Settings			coursu	Junc			Dute	Dalla	Into	
Application [run]			AC500 PM56XX	CPUFW	•	3.1.4.574	3.1.4.574				
📲 Library Manager	Version information		AC500 PM56XX	UpdateFW		3.1.4.82	3.1.4.82				
PLC_PRG (PRG)			AC500 PM56XX	BootFW	\odot	3.1.2.46	3.1.2.46				=
PLC_PRG_FBD (PRG)	Statistics		AC500 PM56XX	DisplayFW	\odot	3.0.0.0	3.0.0.0				
🖹 🎆 Task Configuration											
🖻 💖 Task	Files										~
PLC_PRG		Commu	inication modules								
🖻 🍪 VISU_TASK	Log		Interface Cou	oler Name Devic	e Numb	er Date Firn	nware Type	State Firmw	are	Info	
VisuElems.Visu_Prg	pro cl. II										
🗷 🛃 VisualizationManager	PLC Snell										
VisuPhysAdr	Lisers and Groups										
E-G IO_Bus	users and Groups										
	PM5630-2ETH Hardware										
🖹 😏 🕄 📷 Interfaces											
🕸 😏 🔲 COM_1 (COM 1)											

Figure 30: Run firmware update

3.6.2 Diagnostic

After you are logged in to the BAC/S1.5.1 Building Automation Controller you can read the device protocol by the function **Log** in Automation Builder.

Devices 👻 🕂 🗙	BAC_S_1_5_1_Building_Autor	mation_Co	ontroller 🗙		
BAC-S_1-5-1_Template_Automation Builder_V2-1-		Causa	Time Stamp	Description	Comment
BAC_S_1_5_1_Building_Automation_Controller	Version information	Sever	rime stamp	Description	Component
🖹 🗐 PLC Logic		0	24.10.2018 16:20:24	Channel closed because unused for 60 s	CmpWebServerHandlerV
🖹 🔘 Application [run]	Statistics	0	24.10.2018 16:19:27	Visu_PRG: Successfully Removed Client with IEC-ID: 0	IECVisualization
- Tibrary Manager		0	24.10.2018 16:19:05	Visu_PRG: Successfully Removed Client with IEC-ID: 1	IECVisualization
PLC_PRG (PRG)	Files	0	24.10.2018 15:37:28	Visu_PRG: Creating Client successful for Extern-ID: 13232 R	IECVisualization
PLC_PRG_FBD (PRG)		0	24.10.2018 15:37:28	Visu_PRG: Creating Client for Extern-ID: 13232	IECVisualization
III Task Configuration	Log	0	24.10.2018 15:37:22	Visu_PRG: Creating Client successful for Extern-ID: 13230 R	IECVisualization
🗉 🙀 VisualizationManager		0	24.10.2018 15:37:22	Visu_PRG: Creating Client for Extern-ID: 13230	IECVisualization
VisuPhysAdr	PLC Shell	0	24.10.2018 15:37:22	Webserver started	CmpWebServer
🗉 😏 🕅 IO_Bus		0	24.10.2018 15:37:22	HTTPS is not working with your configuration. See previous I	CmpWebServer
🗏 😏 🔛 🙀 Interfaces	Users and Groups	0	24.10.2018 15:37:22	The needed certificate is not available for HTTPS.	CmpWebServer
⊕ ⊕ □ COM 1 (COM 1)	PMEC20 2ETH Handware	0	24.10.2018 15:37:22	TIsCreateContext: The given namespace 'WebServer' was n	CmpOpenSSL
CAN (<empty>)</empty>	Philoso-22111 Hardware	0	24.10.2018 15:37:22	Visuinitialization done.	IECVisualization
□	PM5630-2ETH Parameters	0	24.10.2018 15:37:22	Visuinitialization starting.	IECVisualization
🖶 😏 🗊 ETH1 (IP Settings)		0	24.10.2018 15:37:22	State was set to RUN	CmpRunStop
😔 😭 NetConfig (NetConfig)	I/O-Bus I/O Mapping	0	24.10.2018 15:37:13	Bootproject is created	CmpRebootMgr
Web Server (Web Server)		0	24 10 2018 15:37:13	Boot parameters were not changed	CmnRebootMar

Figure 31: Protocol of the Controller

The current IP address as well as further information of the BAC/S1.5.1 Building Automation Controller can be read via the ETS **Device Info** function. For this the physical KNX address is necessary. You can determine the address by the ETS function **Programming Mode**.

With the ETS function **Group Monitor** you can analyze the telegrams on the KNX bus. You can also use it to send KNX telegrams.

4 Further Information

4.1 Support and training

4.1.1 Automation Builder

For more information, see the Automation Builder Help. You can open it by clicking the **Help** button. This help and as well as other documents about the products can be found at www.abb.com/plc

On this page you will also find information about the trainings.

Training videos can be found at www.youtube.com/user/abbplc

4.1.2 KNX and ETS

More information about the products, support and training can be found at www.abb.com/knx

The KNX Association offers with the **ETS eCampus** a free online training course about the basics of KNX and the ETS. For more information, visit www.knx.org at MyKNX.

4.2 Software libraries

The ABB Automation Builder is based on the established Software Codesys and can thus easily be extended by third-party IEC61131-3 software libraries.

Providers of such software libraries are, for example

HVAC Library by Pfänder	www.hvac-automation.com
Oscat Library	www.oscat.de

Attention: ABB does not warrant and accept any liability for these third-party software libraries.