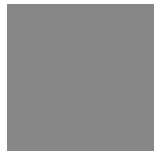


BALLUFF

Software-Description

BVS SMART *CAMERA*

Studio5000™ Add-On Instruction



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1 INTRODUCTION

This Demo Add-On Instruction is an example for the communication with a BVS SC SmartCamera. This Add-On Instruction allows a communication between a Balluff - SmartCamera **BVS SC-_*** and a AllenBradley PLC.

Please test carefully if the Demo AOI is suitable for your application!

The following commands are supported:

Switch Application	Switches the application
Get Application ID	Gets the ID of the currently active application
Get Results	Gets the result container
Send Data	Sets the input data of the application
Get Camera Info	Gets the camera information
Get Date Time	Get the time stamp
Set Date Time	Sets the time stamp
Set Sequence Number	Sets the sequence number

For each *SmartCamera* the AOI has to be called with own instance data.

1.1 General Data

Add-On Instruction name: BVS_SC

Instance data: (each camera has to be called with separate AOI and AOI Tag)

Reserved memory bits: none

Reserved Timers: none

Reserved Counters: none

Associated Data Types SC_Data_Container

I/O Range 128 Byte

Device compatibility: AllenBradley CompactLogix™, ControlLogix™

Software version: Studio 5000, Logix Designer V21

1.2 Recommendations of AOI invoke

The Add-On Instruction should be called only once per *SmartCamera*. Multiple calls of the Add-On Instruction block at the same time are not allowed.

If the Add-On Instruction is conditionally called and the calling condition is false before the Add-On Instruction sets its Ready output, the Add-On Instruction has to be initialized with the "Init" input. If the PLC restarts the "Init" input has to be set for one cycle.

Add-On Instruction parameters can be assigned dynamically if necessary.

2 COMMISSIONING

2.1 AOI Parameter

The I/O data length of the camera unit has a fixed length of 128 Byte. The same length is also used in the AOI.

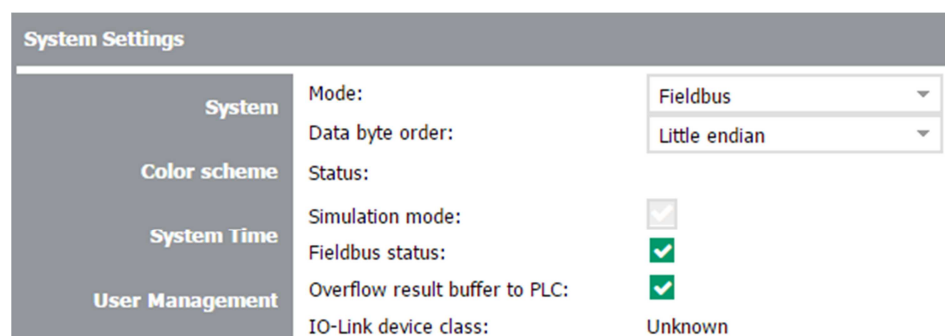
The user defined data type SC_Data_Container is imported into the project along with the AOI.

2.2 AOI Data container

The maximum read/write length of the AOI is 32,767 byte. The data blocks for send- and receive data have to setup according the AOI input parameters **Offset_Send**, **Offset_Receive** and **Data_Length**.

2.3 Camera Setup

For using the Add-On Instruction the byte order have to be set to **Little Endian** in BVS Cockpit system settings. With the setting **Little Endian** data are shown compatible to Allen-Bradley PLC byte order.



(Figure: BVS Cockpit, system settings)

2.4 Process Data Configuration

With the following parameters the SmartCamera can be connected as Generic Device.

Assembly	Instance ID	Data length in Bytes
INPUT	100	176
OUTPUT	101	162
CONFIG	102	26

2 COMMISSIONING

2.4.1 Input Assembly	Startbyte	Length	Description
	0	128	Camera process data input
	128	1	Digital inputs IO-Link port, if configured in IO mode: Bit 0: Pin 4 input data Bit 1: Pin 2 input data
	129	1	IO-Link device state: Bit 0: Device is connected Bit 1: Port in IO-Link mode Bit 2: Validation failed Bit 3: Short circuit between Pin 1 and Pin 3 Bit 4: Pin 4 Overload Bit 5: Pin 2 Overload
	130	32	IO-Link process data input
	162	2	IO-Link vendor ID
	164	3	IO-Link device ID
	167	9	IO-Link 3 events, 1 Byte error code and 2 Bytes detailed code
2.4.2 Output Assembly	Startbyte	Length	Description
	0	128	Camera process data output
	128	1	Digital outputs IO-Link port, if configured in IO mode: Bit 0: Pin 4 output data Bit 1: Pin 2 output data
	129	1	Restart output port after short-circuit detection: Bit 0: Pin 4 Bit 1: Pin 2
	130	32	IO-Link process data output

2 COMMISSIONING

2.4.3 Config Assembly

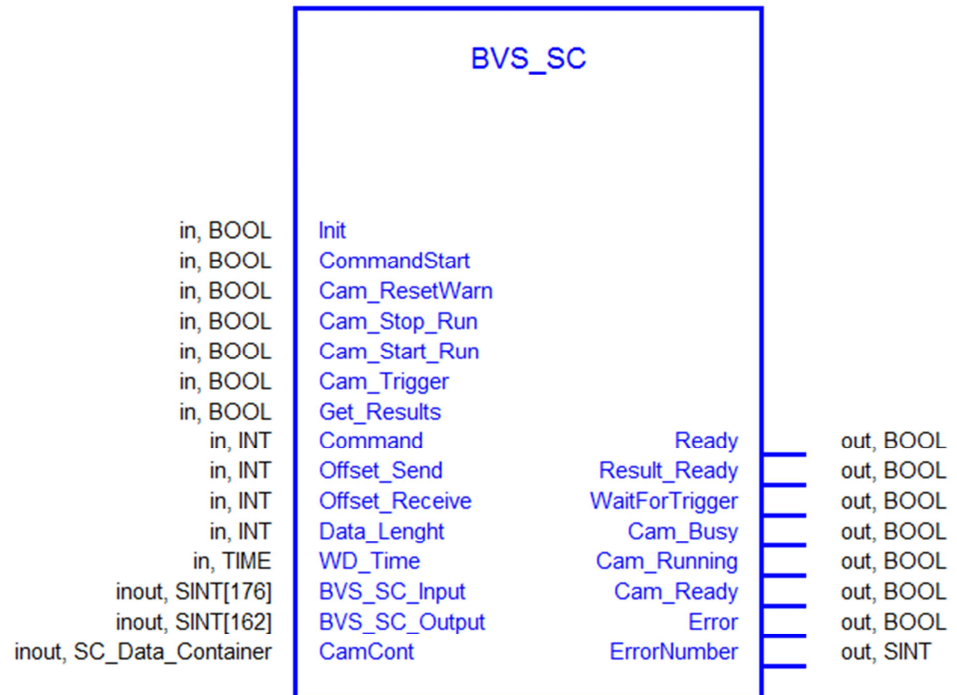
Startbyte	Length	Description
0	2	IO-Link port function 0: Standard-I/O, 1: IO-Link,
2	1	Cycle time Bit 0-5: Multiplier Bit 6-7: Time base
3	1	Validation type 0: No validation, 1: Compatible (VID, DID), 2: Identical (VID, DID, Serial number)
4	2	Vendor ID
6	3	Device ID
9	16	Serial number
25	1	Parameter server Bit 0: Enable upload Bit 1: Enable download Bit 7: Enable parameter server

Configuration Data only updates upon download to the PLC or when power is cycled to the camera.

More information concerning the parameters is available in the BVS SC user's guide.

3 AOI PARAMETER DESCRIPTION

3.1 AOI illustration



“Cam_” = Smart Camera signals

3.2 Input parameter

Init	AOI initialization Must be set for one cycle each time the PLC is restarted. Static variables, control bits and upcoming commands are reset. The function is done when Ready is set again.
CommandStart	Start command. CommandStart = true starts a job. 01 _{hex} - 08 _{hex} . This signal must be set until the Ready output goes to 0. The function is done when Ready or Error is set again. The Input Get_Results can't be set to true at the same time.
Cam_ResetWarn	Reset camera warn bits
Cam_Stop_Run	It deactivates the Run mode of the camera
Cam_Start_Run	It activates the Run mode of the camera. While the signal is on true, the Run mode is restarted if Cam_Running is false.
Cam_Trigger	Initiates a trigger in the camera
Get_Results	Gets the result container from the camera if a rising edge is applied. Same command sequence than command 03 _{hex} . The function is done, when Ready or Error is set again. The Input CommandStart can't be set to true at the same time.

3 AOI PARAMETER DESCRIPTION

Command	<p>Camera commands:</p> <p>Command = 01_{hex}: Switch Application</p> <p>Command = 02_{hex}: Get Application ID</p> <p>Command = 03_{hex}: Get Results</p> <p>Command = 04_{hex}: Send Data</p> <p>Command = 05_{hex}: Get Camera Info</p> <p>Command = 06_{hex}: Get Date Time</p> <p>Command = 07_{hex}: Set Date Time</p> <p>Command = 08_{hex}: Set Sequence Number</p>
Offset_Send	Start address for camera input data in the data container.
Offset_Receive	Start address for camera output data in the data container.
Data_Lenght	Transmitted data length for command 4 (Set inputs).
WD_Time	<p>Monitoring time for commands. This time have to be chosen according to the maximum command execution time. After the expiration of the timer the command is aborted.</p> <p>Example calculation: 32k should be read from the camera. The process data length is only 16 bytes. The PLC cycle Time is 10ms. Calculated data transfer duration 145s.</p>

3.3 Output parameter

Ready	<p>Job completed</p> <p>This bit is set when the job was completed. This output will be reset by a rising edge of Start or Reset input.</p>
Result_Ready	A result in camera is ready.
WaitForTrigger	The camera is waiting for a trigger signal.
Cam_Busy	The camera is currently busy.
Cam_Running	The camera is in run mode.
Cam_Ready	The camera has completely started and is ready. The camera running mode can be started. This output only changes to false. If a Camera reset is executed or if the camera isn't ready for use.
Error	<p>Job completed with error</p> <p>This bit is set if the job was completed with an error and is reset with a rising edge at Reset or CommandStart input</p>
ErrorNumber	If the Error bit is set, the error number will be displayed here as hex value.

3 AOI PARAMETER DESCRIPTION

3.4 Invisible Output Parameter

WarnOvertriggerd	A trigger was discarded by the camera since it was still busy with the analysis of the previous image.
WarnOutBufferErr	This bit becomes active as soon as a result container was not picked up by the controller and overwritten by a new result.
WarnInBufferErr	It is set for input container overflow (more input containers than inspections, so that one input container was discarded) or input container underflow (more inspections than input containers, so that one input container was used multiple times).
WarnOverheat	Camera temperature exceeds the limit.
WarnSystemError	Fatal system error. At least one reset is required, a part of the camera could be defective.

ATTENTION

Warn = Camera Warn-Bits. Warning messages from the camera. The AOI warn bit outputs are invisible AOI outputs. Different camera messages are shown in the warn bits. The warn bits can be used for detailed diagnosis. No other active messages, can be reset by the AOI Input **Cam_ResetWarn**. Commands may be executed, while message bits are active!

3.5 InOut-Parameter

BVS_SC_Input Cyclic PLC Input data from the camera. Length 176 Byte.

Name	Alias For	Base Tag	Data Type	Description
BVS_SC_AOI			BVS_SC	AOI for BVS-SC
BVS_SC_Cam:C			_002B:BVS_SC_1208_EBD45A1F...	
BVS_SC_Cam:I			_002B:BVS_SC_1208_E9D8247A:I:0	
BVS_SC_Cam:I.ConversionFaulted			BOOL	
BVS_SC_Cam:I.Data			SINT[176]	
BVS_SC_Cam:O			_002B:BVS_SC_1208_5DCCDDA6:...	
BVS_SC_Cam:O.Data			SINT[162]	

(Figure: Studio 5000 Controller Organizer, Controller Tags Camera Input Data)

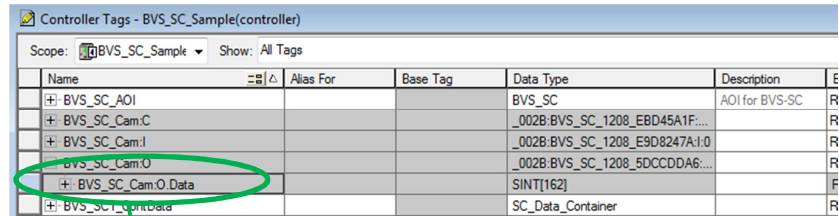
Parameter	Value
AOI for BVS-SC	BVS_SC
BVS_SC	BVS_SC_AOI
Init	0
CommandStart	0
Cam_ResetWarn	0
Cam_Stop_Run	0
Cam_Start_Run	0
Cam_Trigger	0
Get_Results	0
Command	0
Offset_Send	0
Offset_Receive	0
Data_Length	0
WD_Time	10000
ErrorNumber	10#00
BVS_SC_Input	BVS_SC_Cam:I.Data
BVS_SC_Output	BVS_SC_Cam:O.Data
CamCont	BVS_SC1_ContData

The **BVS_SC_Input** input has to be connected with the controllertag **Module_Name:I**

Add-On Instruction for SMART CAMERA

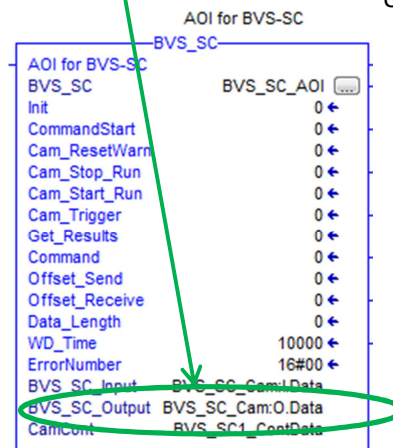
3 AOI PARAMETER DESCRIPTION

BVS_SC_Output Cyclic camera output data to the PLC. Length 162 Byte.



Name	Alias For	Base Tag	Data Type	Description	Access
BVS_SC_AOI			BVS_SC	AOI for BVS-SC	R
BVS_SC_Cam:C			_002B:BVS_SC_1208_EBD45A1F:...		R
BVS_SC_Cam:I			_002B:BVS_SC_1208_E9D8247A:I:0		R
BVS_SC_Cam:O			_002B:BVS_SC_1208_5DCCDDA6:...		R
BVS_SC_Cam:O.Data			SINT[162]		F
BVS_SC1_ContData			SC_Data_Container		R

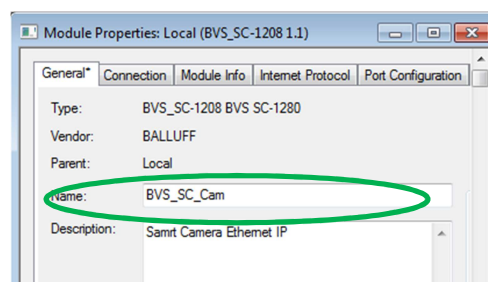
(Figure: Studio 5000 Controller Organizer, Controller Tags Camera Output Data)



The **BVS_SC_Output** has to be connected with the Controller Tag **Module_Name:O**

NOTICE

Module_Name: = is the SmartCamera Module name, given in the ethernet device properties.



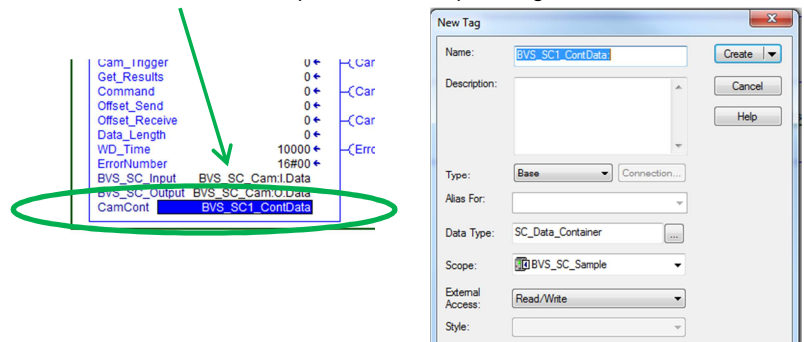
(Figure: Studio 5000 Controller Organizer, Ethernet, Smart Camera Properties)

Add-On Instruction for SMART CAMERA

3 AOI PARAMETER DESCRIPTION

CamCont

Camera data container from data type SC_DataContainer. Senddata that should be transmitted to camera with command 4, have to be stored an array **SendData**. Camera Results, that are transmitted to PLC with Command 3 or AOI Input Get Results, are moved to array **Result**. This Input is required. A new tag can be created by inserting the name at the InOut parameter and pressing <ctrl> + w



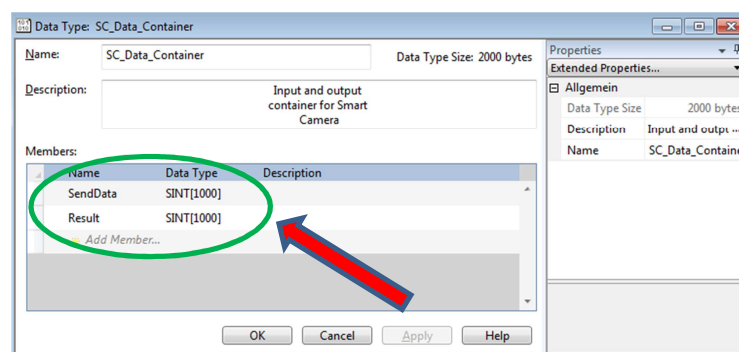
(Figure: Studio 5000, Create New Tag for Camera Container)

The tag for the data container can be created in the Controller scoped tags or in the program scoped tags. The container size for data type SC_Data_Container can be changed if necessary.

Program Tags - BVS_Zyk						
Scope: BVS_Zyk Show: All Tags						
Name	Alias For	Base Tag	Data Type	Description	External Access	
BVS_SC1_ContData			SC_Data_Container	Input and output container for Smart Camera	Read/Write	
BVS_SC1_ContData.SendData			SINT[1000]	Input and output container for Smart Camera	Read/Write	
BVS_SC1_ContData.Result			SINT[1000]	Input and output container for Smart Camera	Read/Write	

(Figure: Studio 5000 Controller Organizer, Program Tags Camera Data Container)

3.6 AOI Data Types



User-Defined Data Type SC_Data_Container. SendData/Result default length 1000 byte. The size can be changed to the maximum of 32,767 byte for SendData and Result. The value [1000] can be edited in column Data Type in the "Members" table.

3 AOI PARAMETER DESCRIPTION

3.7 General error codes

Status-code	Meaning	Effect	Remedy
10 _{hex}	NOK Error	An error occurred during the last transfer of a command	Check command string
11 _{hex}	NOK Communication Abort	Communication was canceled by the controller by resetting the Strobe bit	Check PLC program
12 _{hex}	NOK Communication Error	A communication error occurred (e.g. handshake timeout violation)	Check PLC program
13 _{hex}	NOK Invalid Command	An invalid command code was transferred	Check program string
14 _{hex}	NOK Invalid Application ID	An invalid application ID was transferred during the last command	Transmit valid Application ID
15 _{hex}	NOK Results	Response to the command Get Results; no results present	Start Get Result after Result Ready bit is set
16 _{hex}	NOK Busy	Command could not be executed since the camera is still processing another command or is not yet ready after a restart	Start commands when camera is ready

This error list is corresponding to the status codes in user's manual.

3.8 AOI internal error codes

Status-code	Meaning	Effect	Remedy
30 _{hex}	Monitoring time expired	Camera and AOI go to base state	Check programming
31 _{hex}	Undefined command	Camera and AOI go to base state	Check programming
32 _{hex}	Read /Write length exceeds the limit.	Camera and AOI go to base state	Check programming, Limit 32,767 byte
40 _{hex}	No connection to SmartCamera Modul	Camera and AOI go to base state	Check device configuration and connection, initialize AOI again

3 AOI PARAMETER DESCRIPTION

3.9 Description of commands

The commands are selected by a hexadecimal value at the "**Command**" input. With a rising edge at "**Start**" input the command is executed. After successful execution the "**Ready**" Output is true and "**Error**" is false.

Switch Application ID 01_{hex}:

Switches the camera application. The application ID, stored in the UDT structure "**SC_Dat_Container.SendData**" at the byte address "**Offset_Send**" is transmitted to the camera. The application ID **0** cannot be selected by the fieldbus interface. The application may not be switched during the camera mode Running.

Get Appliaction ID 02_{hex}:

Gets the ID of the currently active application. The Application ID is transmitted to the UDT structure "**SC_Dat_Container.Result**" at the byte address "**Offset_Receive**".

Get Results 03_{hex}:

Gets the camera result container. The result container is transmitted to the UDT structure "**SC_Dat_Container. Results**" at the byte address "**Offset_Receive**".

Send Data 04_{hex}:

Sends camera application input data from PLC to camera. The input data are read from the UDT structure "**SC_Dat_Container.SendData**" starting at the byte address "**Offset_Send**" and transmitted to camera. The amount of data is assigned by the input parameter "**Data_Lenght**". The same length as in camera application tool "Receive data" have to be used.

Get Camera Info 05_{hex}:

Gets the camera information. Camera information are transmitted to UDT structure "**SC_Dat_Container. Results**" starting at address "**Offset_Receive**".

Get Date and Time 06_{hex}:

Get the time stamp from camera. The timestamp is transmitted to the UDT structure "**SC_Dat_Container. Results**" at the start address "**Offset_Receive**".

Set Date and Time 07_{hex}:

Sets the time stamp in the camera. The timestamp is read from the UDT structure "**SC_Dat_Container.SendData**" at the byte "**Offset_Send**" and transmitted to the camera. The transmitted data amount is 7 Bytes.

Set Sequence Number 08_{hex}:

Sets the sequence number. The sequence number is read from the UDT structure "**SC_Dat_Container.SendData**" at the byte "**Offset_Send**" and transmitted to camera. The transmitted data amount is 4 Bytes.

More information concerning the commands is available in the BVS SC user's guide.

4 DISCLAIMER

4.1 Disclaimer of Liability

This demo AOI is free of charge and is a universal application example. This demo AOI shall help program and configure PLC applications and shall provide possible solutions.

The user is not entitled to claim for warranty, error correction and updates. In particular there is excluded any claims against Balluff GmbH for damages that might result from the use of this demo program. Excluded from this limitation of liability shall be (a) those damages that are based on injury to life, limb or health, (b) a liability according to the Produkthaftungsgesetz (German Product Liability Law) and (c) cases of willful intent.

Please check if the demo AOI is intended for your application before adapting it in plants and machineries. By using the Rockwell Studio5000 sample, made available free of charge you accept the limitation of warranty and liability!

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