

SINAMICS G: Speed Control of a G120 with Allen-Bradley controller (Compact/ControlLogix with RSLogix 5000) via EtherNet/IP

SINAMICS G120

[Application Description](#) • September 2013

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SINAMICS G120 EtherNet/IP Application Manual

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Warranty and liability

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1 EtherNet/IP Overview

1.1 Industrial Ethernet

Industrial Ethernet communication networks continue to gain global importance in automation solutions. Industrial Ethernet connectivity down to device level components (i.e. drives, I/O, etc.) is an end user requirement that demands openness and flexibility. To capitalize on the flexibility to connect to different Industrial Ethernet protocols the SINAMICS G120 drives can seamlessly be applied in PROFINET and EtherNet/IP networks.

1.2 SINAMICS G120 Connectivity to EtherNet/IP

The SINAMICS drive family offers both PROFINET and EtherNet/IP software stacks for the SINAMICS G120 series which is easily selected by a parameter setting in the standard SINAMICS firmware.

The network IP address of the G120 drive can be set through the STARTER software. With STARTER software installed on your computer you can connect to the SINAMICS drive through the SINAMICS G120 USB interface.

The SINAMICS drives operate on unicast telegrams which reduces network traffic. SINAMICS G120 drives have been certified by ODVA for EtherNet/IP conformance testing and participated in the EtherNet/IP PlugFest. Siemens is a member of ODVA with Vendor ID # 1251.

EtherNet*✓*IP[™]
conformance tested

2 Solution

2.1 Solution Overview

2.1.1 Hardware Structure

Figure 1 Sample System Overview



2.1.2 System Requirements

- PROFINET versions of SINAMICS G120 with Firmware version 4.6 or later
- Rockwell Automation Logix family controller Firmware version 19 or later.
- RSLogix 5000 Version 20 or later required
- STARTER Version 4.3 SP2 or later

NOTE RSLogix 5000 Version 19 can be used when not using the EDS file

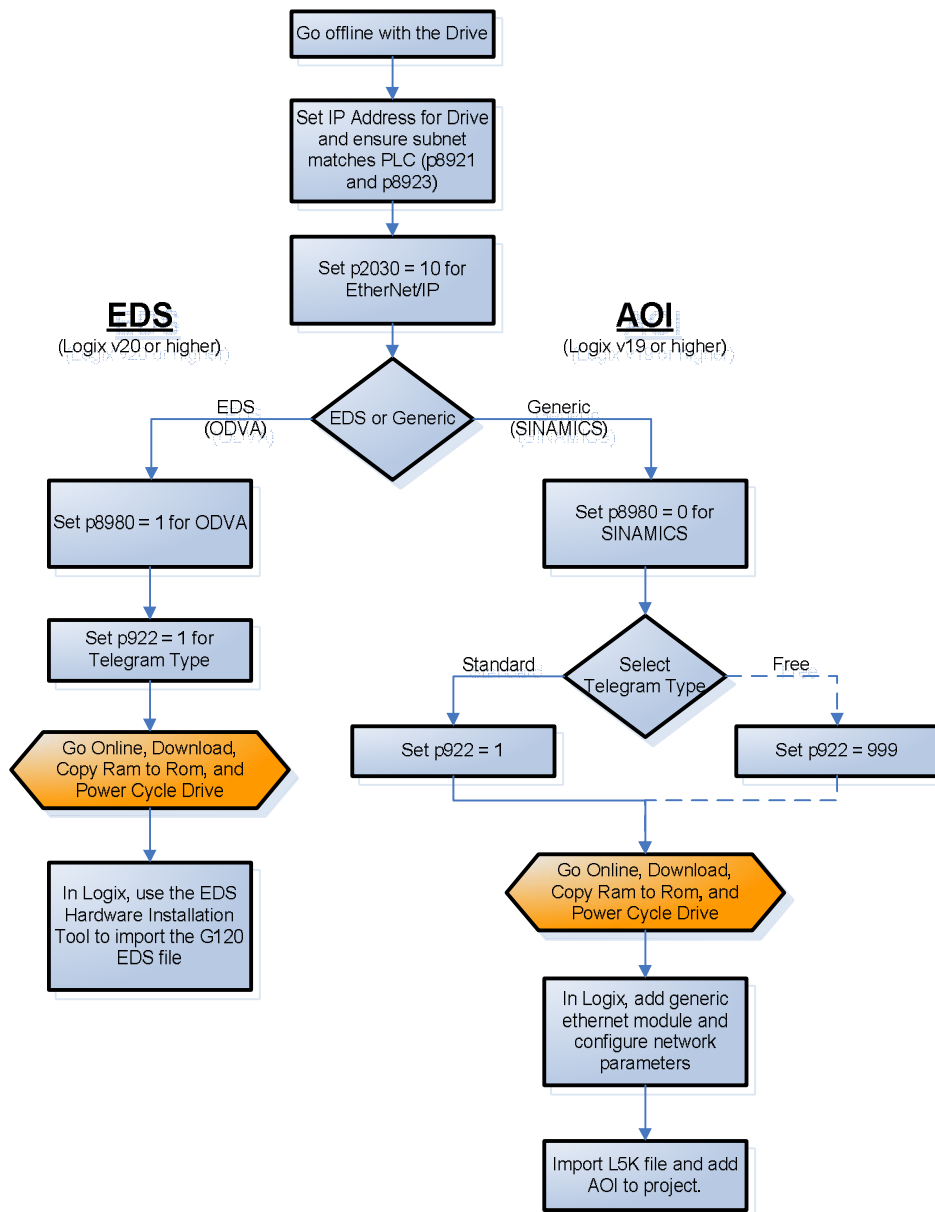
2.1.3 Network Connections

The SINAMICS G120 Ethernet Communication Interface is selected with parameter P2030 to operate either the PROFINET or EtherNet/IP software stack. Based on P2030 both ports of the G120 operate the same selected software stack and cannot be programmed individually. Either software stack will also support standard Ethernet TCP/IP telegrams on both ports.

2.2 Programming Overview

2.2.1 Configuration Methods

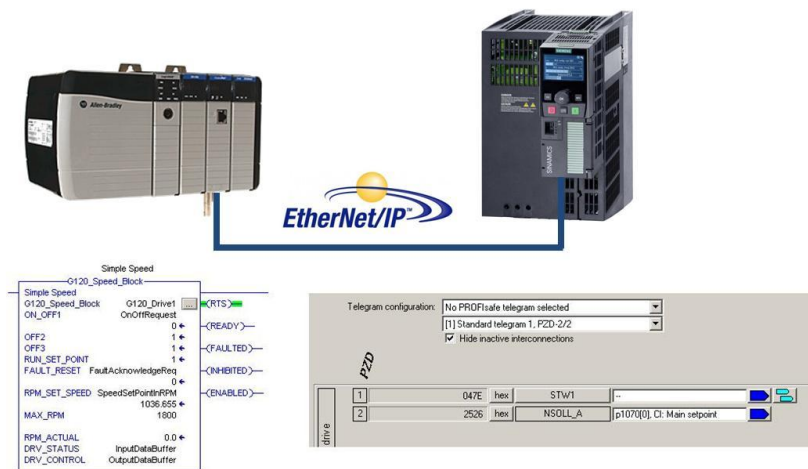
There are two methods to configure a SINAMICS G120 to communicate over EtherNet/IP. This manual will focus on the SINAMICS approach to configuration using Add On Instructions. This approach requires version 19 or higher for RSLogix 5000. Alternatively, the drive can be set up for ODVA type configuration. This allows the user to import a SINAMICS G120 EDS file and treat the drive as an ODVA AC drive object. This approach requires version 20 or higher for RSLogix 5000. Refer to the diagram below for a general overview of the steps to configure with either method.



2.2.2 AOI's for SINAMICS G120 drives

The EtherNet/IP telegrams to the SINAMICS G120 drives can be freely configured using the free telegram structure for the message frame type. Alternatively in an effort to seamlessly integrate the communication between an SINAMICS G120 drive object and an AB Logix family controller **Add On Instructions** have been designed for the RSLogix programming that mimic standard telegrams used in SINAMICS G120 configurations. For most standard applications the use of the AOI's can greatly reduce the Engineering time to configure a system. This manual documents the use of the AOI's developed to simplify the integration of SINAMICS drives connected to RSLogix automation systems over EtherNet/IP.

Figure 2 Example utilizing Simple Speed AOI and Standard Telegram 1



2.2.3 AOI Description

There is presently one Add On Instruction block designed to coordinate with standard telegram 1 used in SINAMICS G120 type drives. Additional AOI's will be developed for applications including positioning.

1. Simple Speed (Standard Telegram 1)

Standardtelegramm-1:

PZD-Nummer	1	2
Sollwert	STW1	NSOLL_A

PZD-Nummer	1	2
Istwert	ZSW1	NIST_A

3 SINAMICS G120 Add-On Instruction

3.1 Function Description

The Drive control function block (AOI) described in this section is intended to provide SINAMICS G120 users with a quick and effective way to integrate the SINAMICS G120 drives into an automation system where a Logix family controller is the primary control. The AOI can also be used as a starting point since the user is free to customize it to fit their specific application. The canned AOI in this application guide has been designed to seamlessly integrate with the PROFIdrive telegram 1, commonly used for controlling SINAMICS G120 drives.

3.2 Telegram Description

3.2.1 Telegram Type 1 for Simple Speed

This telegram is a standard PROFIdrive telegram of 2 words in length. It will control the state of the drive by selecting the appropriate bits in the control word and set the running speed in the speed setpoint word. For additional information on this telegram and the details of its function, refer to the SINAMICS G120 Operating Instructions Manual.

Table 1 Telegram Type 1

WORD	INPUT	OUTPUT
1	Control Word 1	Status Word 1
2	Speed Setpoint Value	Actual Speed Value

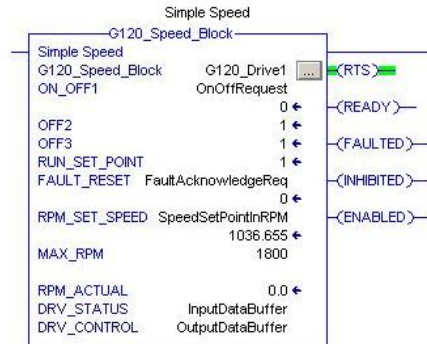
3.3 Simple Speed Control

3.3.1 Functionality

The SINAMICS G120 Simple Speed Block provides an interface for basic speed control of a drive object in SINAMICS via EtherNet/IP. The Drive is configured for control using Standard telegram type 1 which presets the drive speed reference and control word to be sourced from the communication interface.

3.3.2 Schematic Ladder Representation

Figure 1 G120 Simple Speed Block



3.3.3 Input and Output Parameters

Table 2 Input Parameters

Variable Name	Data Type	Description
G120_Speed_Block	Instance Data	
ON_OFF1	BOOL	Drive Enable (ON/OFF1) 1 = Enable Drive 0 = Ramp Down and Disable drive
OFF2	BOOL	Coast Stop Command 0 = OFF2 Immediate Disable 1 = No OFF2 Command
OFF3	BOOL	Fast Stop Command 0 = OFF3 Fast Ramp and Disable 1 = No OFF3 Command
RUN_SET_POINT	BOOL	Speed Setpoint Enable 0 = Setpoint Disabled 1 = Setpoint Enabled
FAULT_RESET	BOOL	Reset Active Fault(s) 0 = No Fault Reset 1 = Reset Fault on Rising Edge
RPM_SET_SPEED	REAL	Speed Setpoint in RPM
MAX_SPEED	REAL	Speed at 100% Setpoint Must be the same as P2000

3.4 UDTs

Table 3 IN/OUT Parameters

Variable Name	Data Type	Description
DRV_CONTROL	ARRAY	Array of 2 integers referenced to the two outputs words of the drive telegram.
DRV_STATUS	ARRAY	Array of 2 integers referenced to the two input words of the drive telegram

Table 4 Output Parameters

Variable Name	Data Type	Description
RTS	BOOL	Ready to Start
RDY_OP	BOOL	Ready for Operation
FAULTED	BOOL	Fault is Active
ENABLED	BOOL	Pulses are Enabled
RPM_ACTUAL	REAL	Actual Speed in RPM

3.4 UDTs

UDTs are provided as representing the typical control and status words used for Telegrams implemented by the AOI provided. This cannot be utilized when using the provided EDS file. The UDTs can also be used independently to map IO data sent and received by the drive. The user application is able to directly control the telegram words and bits to accomplish control concepts not included in the AOIs provided by Siemens. This is the case when using user defined telegrams (free telegram configuration with BICO) to exchange data with the drives.

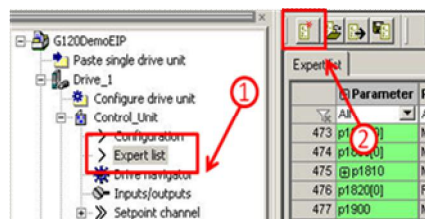
4 Drive Configuration

Initial commissioning of the SINAMICS G120 drives is not in the scope of this document. Refer to the SINAMICS G120 Getting Started Manual to assist in the commissioning of the drive(s). This sample application referenced in this document utilizes the SINAMICS G120 training unit.

4.1 Configuration in STARTER

4.1.1 Parameter Setting for Simple Speed AOI

In offline mode, navigate to the expert list. Select „create new user-defined parameter list“.



Enter in the following parameter numbers: 922, 8921, 8923, 8925, and 2030.

Set them to the following values:

- p922 = [1] Standard telegram 1
- p8921 = unique IP address with the same subnet as the EtherNet/IP controller
- p8923 = appropriate subnet mask
- p8925 = [2] Activate and Save configuration
- p2030 = [10] EtherNet/IP
- p8980 = [0] SINAMICS

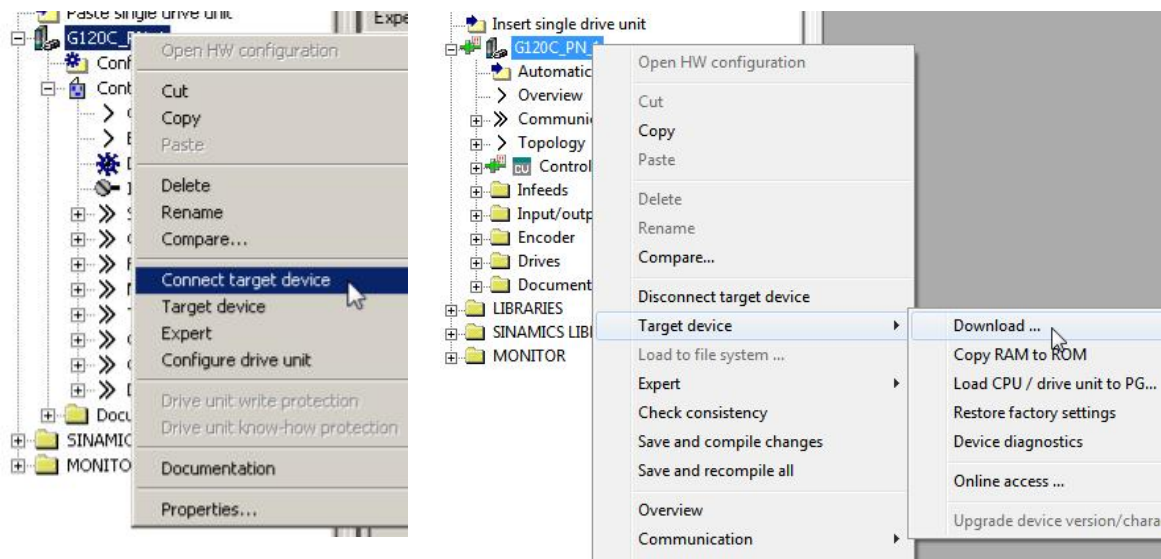
	Parameter	Parameter text	Offline value	Control_Unit	Unit	Modifiable to	Access level	Mi
1	p922	PROFdrive PZD telegram selection	[1] Standard telegram 1, PZ...			Ready to run	1	
2	p8921	PN IP address of station				Operation	3	0
3	p8921[0]	PN IP address of station	192			Operation	3	0
4	p8921[1]	PN IP address of station	168			Operation	3	0
5	p8921[2]	PN IP address of station	1			Operation	3	0
6	p8921[3]	PN IP address of station	108			Operation	3	0
7	p8923	PN Subnet Mask of Station				Operation	3	0
8	p8923[0]	PN Subnet Mask of Station	255			Operation	3	0
9	p8923[1]	PN Subnet Mask of Station	255			Operation	3	0
10	p8923[2]	PN Subnet Mask of Station	255			Operation	3	0
11	p8923[3]	PN Subnet Mask of Station	0			Operation	3	0
12	p8925	PN interface configuration	[2] Activate and save confi...			Operation	3	
13	p2030	Field bus int protocol selection	[10] Ethernet/IP			Ready to run	1	
14								

4.2 Using a Freely Configurable Telegram

Refer to the picture below for the following steps:

1. Using the S7USB as your PG/PC interface, right-click the drive (in the project navigator) and select „Connect target device“
2. Download to the drive
3. Copy RAM to ROM
4. Go offline and cycle power to the drive

The SINAMICS G120 is now set to operate as an EtherNet/IP adapter.



Note

Go online and verify that the IP Address (set in p8921) is now displayed in r8931. If the IP Address is not stored in r8931, use the alternate method in STARTER to set the IP address using “Edit Ethernet Node” utilizing the Ethernet interface. Refer to the Appendix for further information.

4.2 Using a Freely Configurable Telegram

It is possible to configure a custom telegram to fit a specific application requirement. The custom configuration can be accomplished by one of several methods listed.

1. Using a standard telegram as a template and changing the configuration manually.
2. Selecting the input and output data length and connecting the telegram words in the communications window of the drive configuration.
3. Configuration by Script execution. A script can be written in STARTER which configures the telegram size and connections required. The script is then executed in STARTER configuring the drive.

Parameter r2067 displays the number of PZDs the controller detected to be part of the telegram for the Drive Object. In the figure below the message frame configuration shows the Input and Output data length which must match the values calculated by the controller in r2067 of the specified Drive Object.

Note

In order for the CU to correctly calculate parameter r2067, the last PZD of the telegram must be interconnected.

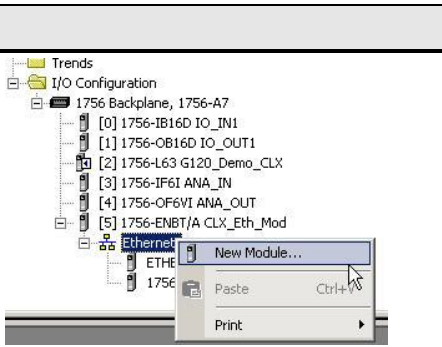
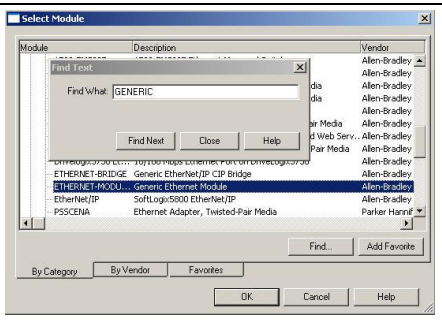
5 Configuring a Generic Ethernet Module

5.1 Adding a new module in RSLogix

A Generic IO module is used to configure the cyclic data exchange between the automation controller and the SINAMICS drive without an EDS file.

5.1.1 Inserting the module in an RSLogix project

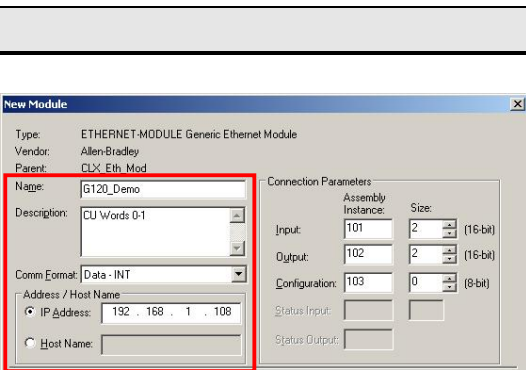
Table 1 Inserting the Module

<p>1. Insert a module by right clicking the network interface in the IO configuration section of the Project tree.</p>	
<p>2. In the "Select Module" dialog box use the Find function to search for the term "GENERIC". Select the "Generic Ethernet Module" module to be inserted.</p>	

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5.1.2 Configuring network parameters

Table 2 Configuring the Network Parameters

<p>The module name should identify the G120 to allow easy selection from other modules configured in the controller. It is also the name used for the controller level tag that will hold the data. Use the Description box to describe the Drive objects contained in the module.</p>	
<p>The data exchange format should be set to Integer (INT).</p>	
<p>Enter the IP Address of the G120.</p>	

<p>The Connection Parameters section configures the IO Assemblies. The Assembly Instances should always be 101 through 103 for the Input, Output and Configuration Assembly respectively. The size of the Input and Output assemblies is the total number of words. For Standard Telegram 1, there are two words in and two words out.</p>	
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--

5.1.3 Connection Parameters

Table 3 Setting the Connection Parameters

1.	<p>The Requested Packet Interval (RPI) is the rate at which the controller will exchange data with the drive. The SINAMICS G120 can operate with a RPI set to a minimum of 5 ms. In this application we will use a value of 10 ms.</p>	
2.	<p>2) Unicast is selected as the exchange method.</p>	

5.1.4 Using the IO Data

The IO data is available as an array of integers in the controller tags section of the project tree. They are included as a tag list with the L5K file.

Figure 1 Controller Tags for new module

Name	Value	Force Mask	Style
Flasher1Hz	0		Decimal
[-] G120_Demo:C	{...}	{...}	
[+] G120_Demo:I	{...}	{...}	
[-] G120_Demo:I.Data	{...}	{...}	Decimal
[+] G120_Demo:I.Data[0]	0		Decimal
[+] G120_Demo:I.Data[1]	0		Decimal
[+] G120_Demo:O	{...}	{...}	

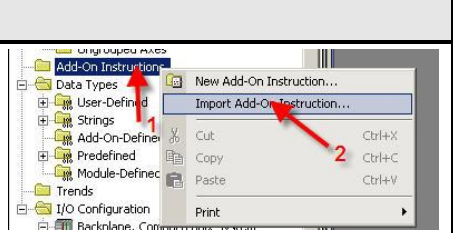

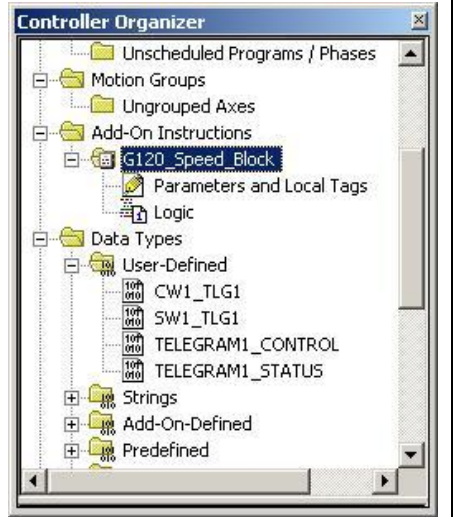
6 Using AOIs in a new Application

6.1 Importing AOIs

The AOIs provided with the sample application can be easily integrated into a new or existing user program by importing the instructions using L5K files.

6.1.1 Installing L5K Files in RSLogix

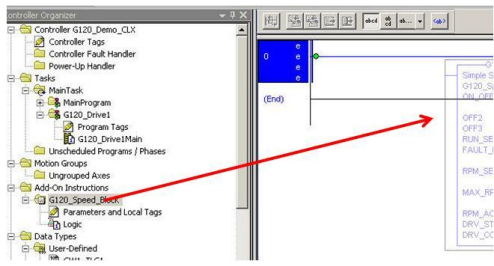
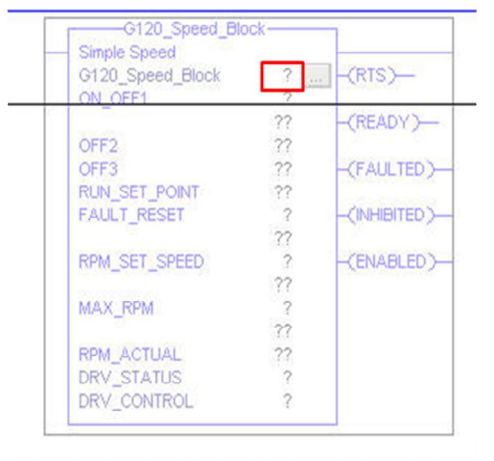
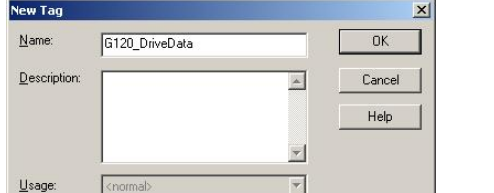
Table 1 Steps to Importing the AOIs

<p>3.</p>	<p>Import the AOI into the Add On Instructions folder. Right click the Add-On Instructions folder in the project tree and select the Import Add-On Instruction option.</p>	
<p>4.</p>	<p>Select the required L5K file for the desired Instruction and click Import. Review the Import configuration and click OK.</p>	
<p>5.</p>	<p>The Project should now show the imported Instruction. Notice that UDTs required for the instruction have also been imported. These UDTs can also be used to create additional variables and aliases.</p>	

6.2 Using the AOI

6.2.1 Adding AOI to an RSLogix Program

Table 2 Using the G120 Simple Speed Block

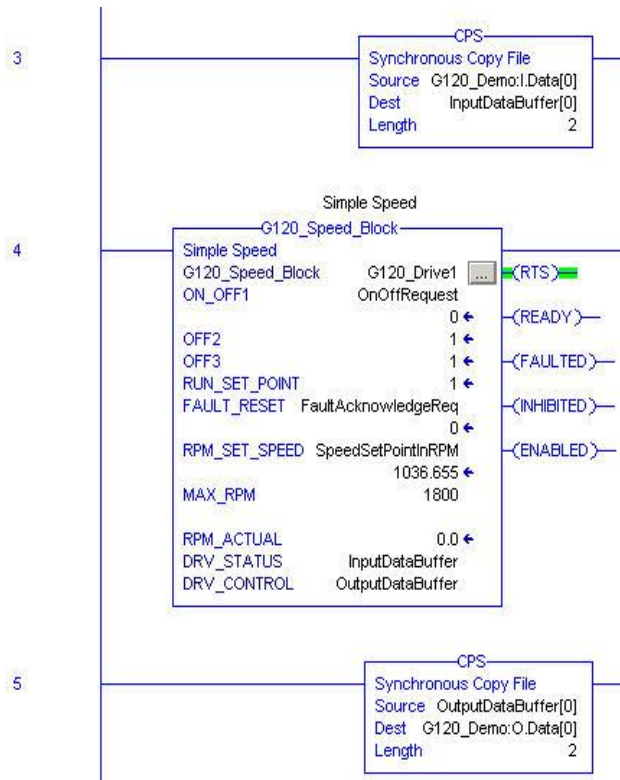
6.	Add AOI to a new rung by dragging from project tree.	
7.	Declare and assign instance data variable. The new tag can be created as a local program tag with a name that clearly identifies the drive data. Right click the field next to G120_Speed_Block and select New Tag.	
8.	Give the tag a descriptive name and select OK	

6.2 Using the AOI

6.2.2 I/O Interface

Connecting the instruction to the Controller IO tags is accomplished by moving the IO data into the AOI Interface.

Figure 1



The second rung holds the AOI. The local variables "InputDataBuffer" and "OutputDataBuffer" are used as storage for the AOI to receive and send data to the Controller IO tags.

The first rung copies the IO data for the drive to a local variable to be used by the AOI as inputs in the "DRV_STATUS" parameters. "DRV_STATUS" and "DRV_CONTROL" is declared as INOUT parameters and therefore passed by reference.

The third rung holds the copy command that moves the control data from the working variable "OutputDataBuffer" to the controller IO tag.

All AOIs provided will use this method of data exchange with IO containing the drive data. Additional access to the control data can be performed before the data is copied to the IO Tag. This allows the user to utilize features already mapped in the telegram that are not control by the AOI. In a similar manner the Status data can be access by the user program.

7 Glossary

AOI (Add On Instruction): Commonly used logic for a task that is encapsulated into a block to be reused in RSLogix programs

BICO: BICO technology (Binector Connector Technology) allows the drive to be adapted to a wide variety of requirements. Digital and analog signals which can be connected freely by means of BICO parameters, are identified by the prefix BI, BO, CI or CO in their parameter name.

Control Word: Arrangement of two bytes used to command the drive sequence control (referred to as STW1 in SINAMICS Documentation)

EDS File: Text files used by RSLogix network configuration tool to help identify products and easily integrate them on a network

Free Telegrams: The send and receive telegrams can be configured as required by using BICO technology to interconnect the send and receive process data.

L5K file: File type used for importing an AOI into RSLogix program

MDI (Motion Direct Input): Direct setpoint input function for positioning

ODVA: Open DeviceNet Vendors Association. Organization that supports network technologies built on the Common Industrial Protocol (CIP™) — DeviceNet™, EtherNet/IP™, CompoNet™, and ControlNet™

PN Interface: PROFINET interface

PROFIdrive: Device profile to provide standardization of drive telegram type thus minimizing integration and commissioning time and effort.

Siemens Standard Telegrams: Structured in accordance with manufacturer specification with the internal process data links automatically set up in accordance with the telegram number setting.

Standard PROFIdrive Telegrams: Structured in accordance with PROFIdrive profile with the internal process data links automatically set up in accordance with the telegram number setting.

STARTER: Software for Siemens SINAMICS drives configuration and diagnostics

Status Word: Arrangement of two bytes used to report the current status of the drive (referred to as ZSW1 in SINAMICS Documentation)

Telegram type 1: Standard PROFIdrive telegram of two words for simple speed control

UDT: User Defined Type holds data relevant to the device

Vector mode: Axis control type including closed loop, open loop, and V/Hz speed control. Typically used with induction motors to obtain high speed and low torque ripple.

8 History

Table 8 History

Version	Date	Changes
V1.0	03.28.2013	Initial Release

9 Appendix

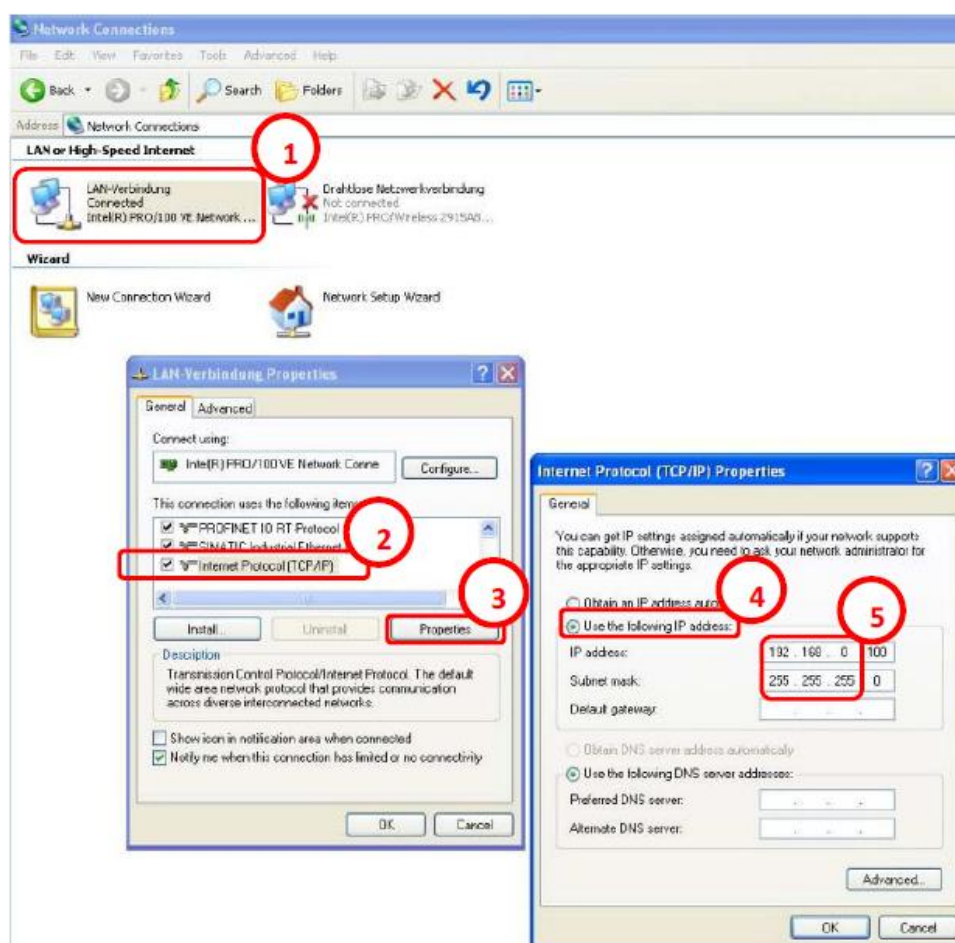
9.1 Setting the IP Address through Edit Ethernet Node

While Online with the S7USB, ensure that parameter p2030 is set to PROFINET. Copy RAM to ROM and power cycle the drive.

Connect only the Ethernet cable from the SINAMICS G120 interface X01 P2 to the Ethernet interface (port) of your PG/PC. This should be the only Ethernet cable connected to the SINAMICS G120.

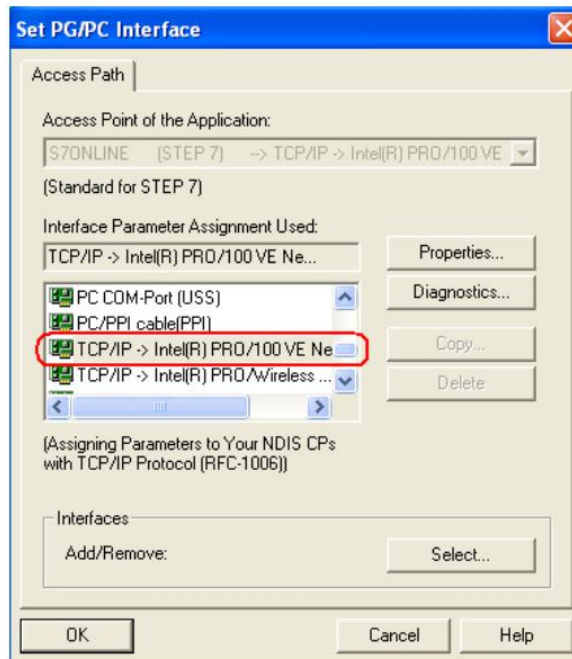
Set the IP address and the subnet mask of the Ethernet card of your PG/PC. Ensure that the subnet of your PC and SINAMICS G120 match.

1. Right Click your LAN adapter and select "Properties"
2. Highlight the Internet Protocol item (this may be called TCP/IPv4)
3. Click Properties
4. Select "Use the following IP address"
5. Enter in a unique IP address where the subnet matches the G120's subnet. The default IP address of the G120 is 0.0.0.0. Therefore, if this is the first commissioning of the drive, set your PG/PC's IP address to 0.0.0.100 with the subnet mask set to 255.255.255.0.

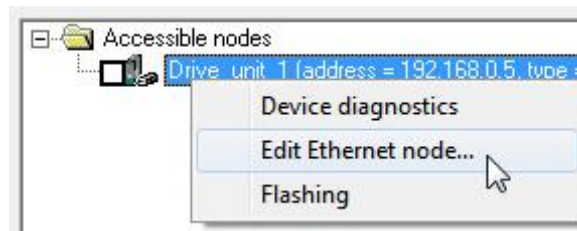


9.1 Setting the IP Address through Edit Ethernet Node

In STARTER, go to Options > Set PG/PC Interface.... select the TCP/IP interface parameterization. Click OK.



Go to Project > Accessible Nodes. If the window doesn't automatically search for drives on the network, click "Update". Right-click the found drive unit and select "Edit Ethernet Node".



1. Enter the desired IP address and Subnet Mask. Ensure the IP address has the same subnet as the Logix controller
2. Press the Assign IP Configuration button.
3. After completing the IP configuration assignment, enter the device name - assigned in HW Config - under Device name: (in this particular function example, SINAMICS G120).
4. Assign this to the SINAMICS G120 by pressing the Assign Name button.
5. Close the screen by pressing the Close button.

9.1 Setting the IP Address through Edit Ethernet Node

1.

2.

3.

4.

Disconnect the Ethernet cable from the SINAMICS G120, and reconnect to the unit via S7USB. Set your PG/PC interface for S7USB. Proceed to the beginning of section 5.1.1 in the “SINAMICS G120 EtherNet/IP Application Manual” to set up the drive for Ethernet/IP communication.