

SIEMENS



SIMATIC S7-1200®™

**Communication software for burner controls
LME39..., LME7... and LMO39... via BC interface**

**BC interface (RS-485) between PROFINET /
PROFIBUS**

Software Documentation

Guarantee and liability



Note:

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Application objectives

- Use of the burner controls in industrial environments
- The burner controls control the burner in order to generate steam, hot air, and other thermal operating materials
- The burner controls communicate with the burner via a serial protocol

This document presents an example of how a burner control could be connected to an industrial controller from the SIMATIC S7 family.

Key aspects of the application

The following key aspects are addressed in this application:

- The required hardware components
- Configuration in STEP7 V11
- Integration of the required software components

Validity

Valid for STEP7 version 11.

Supplementary documentation

Data sheet LME39.....	N7106
Basic documentation LME39.....	P7106
User Manual PME71.111.....	A7105.1
User Manual PME71.112.....	A7105.2
User Manual PME71.401.....	A7105.3
User Manual PME71.402.....	A7105.4
User Manual PME71.901.....	A7105.5
User Manual PME72.521.....	A7105.11
User Manual PME72.541.....	A7105.12
User Manual PME73.810.....	A7105.21
User Manual PME73.811.....	A7105.22
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User Manual PME73.820.....	A7105.24
User Manual PME73.830.....	A7105.25
User Manual PME73.831.....	A7105.26
User Manual PME73.840.....	A7105.27
Data sheet LME7.....	N7105
Basic documentation LME7.....	P7105
Data sheet LMO39.....	N7154
Basic documentation LMO39.....	P7154

Writing conventions used within the document

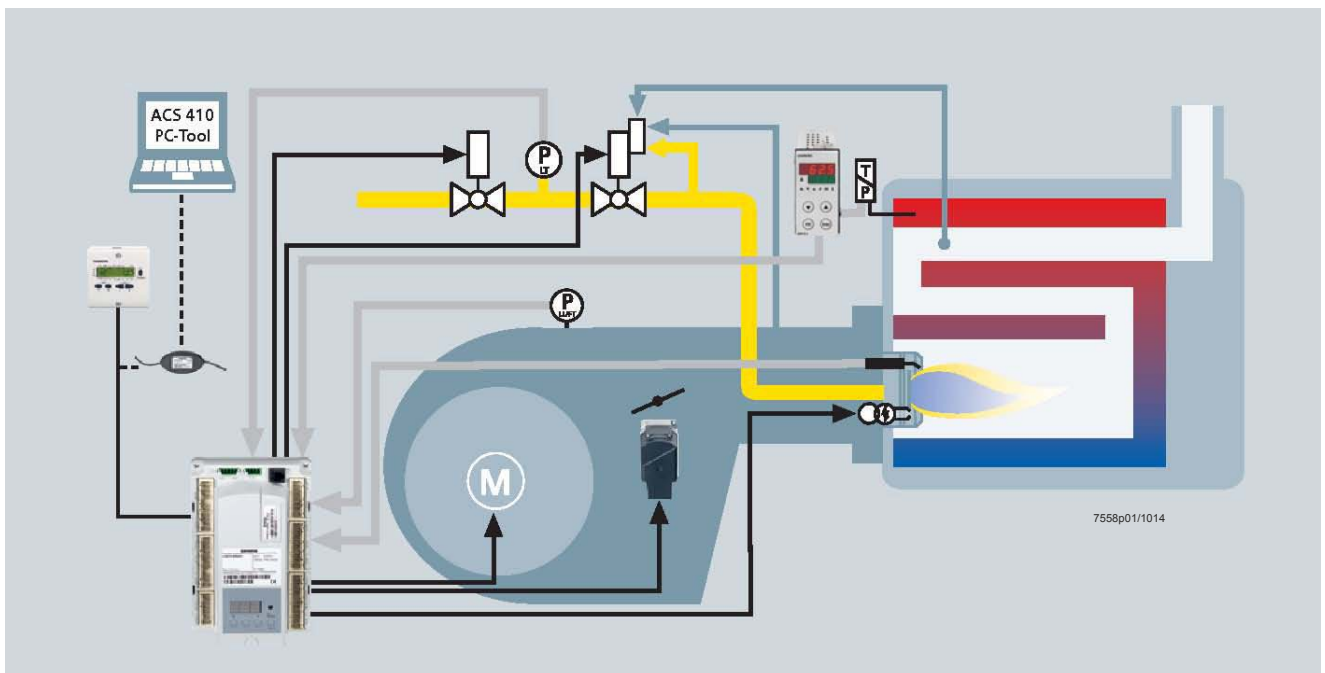
Communication module.....	CM1241 or CB1241
Burner control.....	LME 3 / LME7 / LMO39 or LME / LMOs
Display and operating unit.....	AZL2 or AZL
Interface module.....	OCI412.10

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1 Introduction

The burner controls are integrated into a PROFINET network using the connection software described below. The connection is based on a BC interface connection to SIMATIC S7-1200. The actual values can be measured.



Status and fault information
Current phase
Diagnostic data
Current fault
Current error
Startup counter
Flame signal
Actuator position (LME7)

Figure 1: Integrating the burner control into a PROFINET network

1.1 LME / LMO / SIMATIC S7-1200

The burner controls are connected via the OCI412.10 interface module. The OCI412.10 converts the level of the TTL signals to RS-485 with galvanic separation. The OCI412.10 supplies the data in the BC interface protocol via an RS-485 interface. At the SIMATIC S7-1200, the connection is established via CM1241 or CB1241 for RS-485.

The CM1241 / CB1241 supports the BC interface protocol.

1.2 Scope

This application does not contain descriptions concerning:

- How to operate the burner controls
- Installation guidelines for the SIMATIC S7-1200 automation system
- Installation guidelines for the burner controls
- Serial communication

1.3 Assumed knowledge

A basic knowledge of how to configure and commission a SIMATIC S7-1200 is assumed.

2 Overview of the complete solution

2.1 Description of the key functions

2.1.1 How the key functions work

This application carries out the protocol processing operations required in order to read out process values from the burner controls. The burner controls are connected to the serial interface of the PLC and the required function modules (FBs) are called up.

Individual burner controls can be connected via a point-to-point (PtP) connection.

LME driver modules are used.

2.1.2 Advantages of this solution

The solution presented here offers the following advantages:

- Saves time and costs
- Can be extended
- Can be integrated in existing automation systems

2.2 Bus connection

A transmission speed of 19200 Baud is set for data exchange with the burner controls in the BC interface protocol.

The illustrations below depict the basic bus connections.

2.2.1 LME / LMO

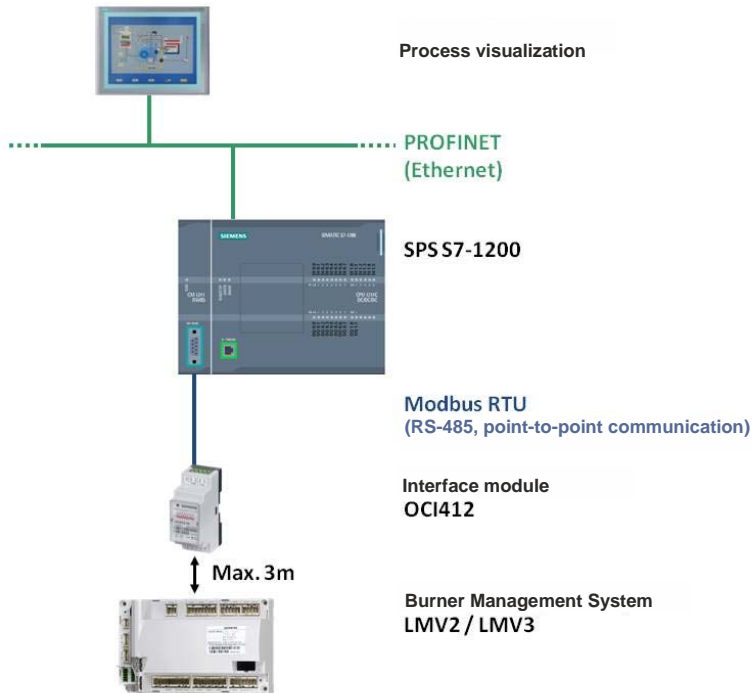


Figure 2: LME / LMO point-to-point bus connection

2.3 Hardware and software components used

The application was created using the following components:

2.3.1 Hardware components for a burner control connection

Component	No.	MLFB / Order number	Note
SIMATIC S7-1211C DC / DC / RELAY	1	6ES7211-1HE31-0XB0	Option: Use of a different SIMATIC S7-1200 CPU
CM1241 (RS-485)	1	6ES7241-1CH31-0XB0	Option: Use of CB1241 (RS-485)
Sub-D connector (pin)	1	---	---
Interface module	1	OCI412.10	---

Table 1: Hardware components for a burner control connection

2.3.2 Standard software components

Component	No.	MLFB / Order number	Note
STEP7 V11 Basic	1	6ES7810-4CC10-0YA5	Option: <ul style="list-style-type: none">• Use of STEP7 V11 Professional• Use of STEP7 V1x TIA Portal

Table 2: Standard software components

3 Principles

The principles of serial communication

Serial communication:

The data bits of an information unit are transferred in chronological order via a medium.

The following physical transmission media is defined:

- RS-485

These standards define the levels and the transitions between the levels over time in order to transfer a logic 1 or a logic 0.

The transmission protocol defines the relevance of the logic values sequence.

4 Function mechanisms of this application

4.1 General overview

BC interface communication is based on the master/slave principle. Communication is completely controlled by the master. Slaves respond only to requests from the master and send a response packet. For this connection, the burner controls are always slaves and the SIMATIC S7-1200 is the master.

Calling up the corresponding LME driver module from the *BC interface basic modules* library establishes the connection to the burner controls and the process values are refreshed cyclically.

4.2 Program overview

4.2.1 Point-to-point communication

The driver modules operate according to the principle of a state machine and are implemented accordingly. A different task for establishing communication is performed in each state. Switching from one state to another is triggered by an event.

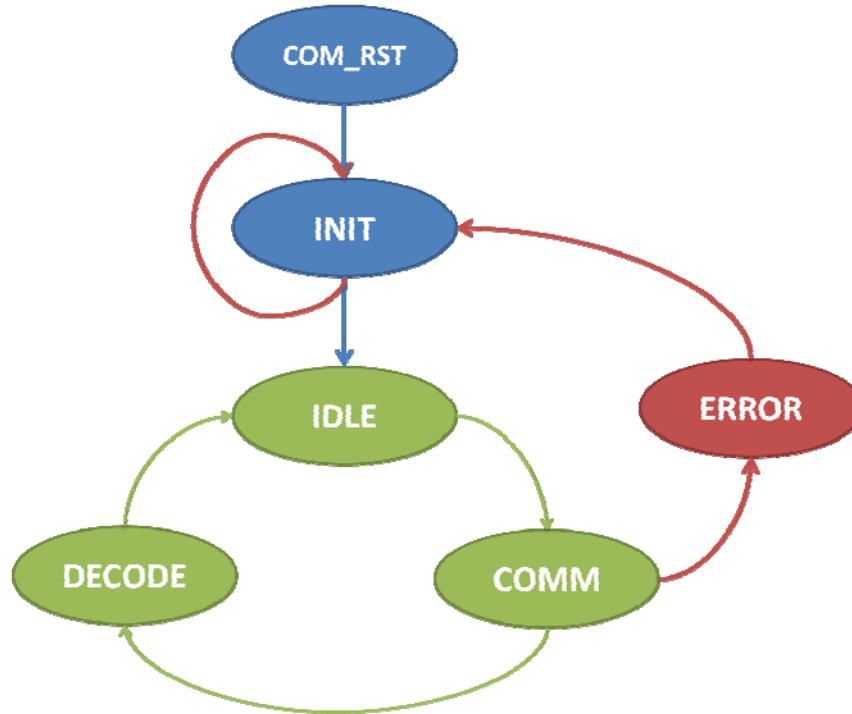


Figure 3: Diagram of states for the driver modules

The program structure for point-to-point communication between a SIMATIC S7-1200 and a burner control is illustrated in the figure above and is divided into 3 areas:

- Initialization (blue)
- Error-free communication (green)
- Error (red)

COM_RST triggers a communication configuration with the aid of SIMATIC S7-1200 system module *MB_COMM_LOAD*.



Note!

Please note that *MB_COMM_LOAD* sometimes overwrites the set port configuration of the communication module.

INIT continues to prepare communication and checks the validity of the slave address.

Next, *IDLE* generates communication commands. These determine which variables are to be written or read with the next communication. When a command is pending, the module switches to its *COMM* state.

In *COMM* state, the send job is executed by the *MB_MASTER* system module. In the event of a communication error, the module switches to its *ERROR* state, and, in the case of error-free communication, to its *DECODE* state.

In *DECODE*, the data placed in the data buffer by *MB_MASTER* is evaluated and assigned to the corresponding variables within the PLC. The validity of some of this data is checked. If the information is invalid, the data is not requested a second time. A note indicating invalidity is placed in the *Status* output variable (see the table below). This data is refreshed according to a specific cycle. This ends the processing of a command and a new one can be processed in the *IDLE* state.

The *ERROR* state resets certain program control variables and stores the error code in the data module of the driver module under *grLastError.CommError*.

A new command can then be moved to *IDLE*.

Status	
Bit no.	Checks parameter: *
0	CurrentPosFuel
1	CurrentFuel
2	TotalHours
3	ModbusDowntime
4	Communication_Error
5	ProgramStop
6	CurrFlowRate
7	---
8	---
9	CurrentO2Value
10	FlameSignal
11	CurrentOutput
12	Phase
13	ErrorCode, DiagCode, ErrorClass, DiagClass
14	---
15	TotalStartCount

* If *TRUE*, the parameter is within the valid range

Table 3: Checking validity using the Status output variable

4.3 Wiring the serial interface

4.3.1 Wiring the burner control connection




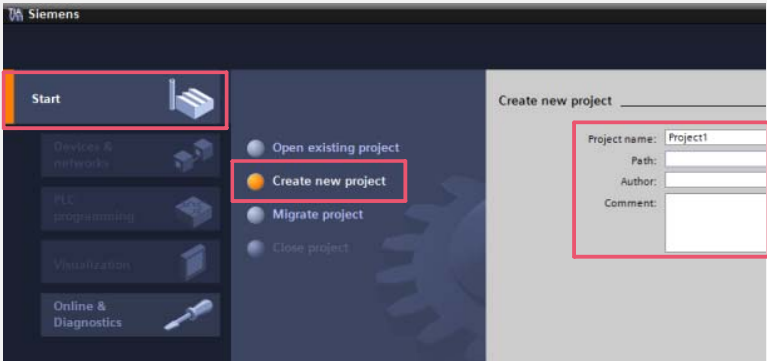

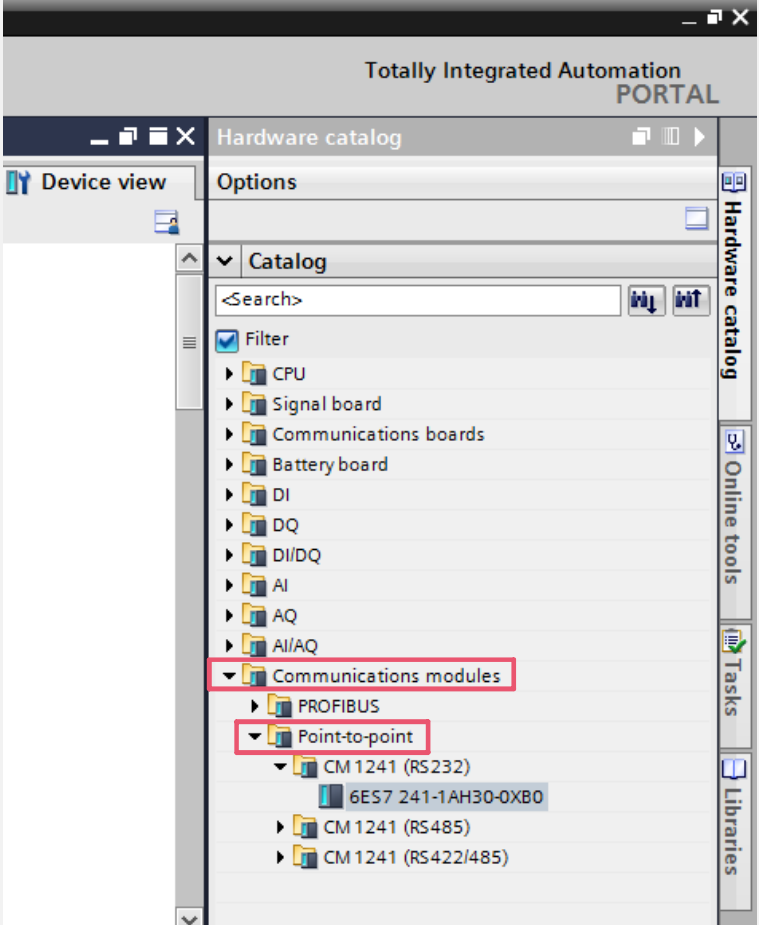
No.	Action	Note
1.	Connect the CM1241 (RS-485) to the SIMATIC S7-1200 CPU	A maximum of 3 communication modules can be installed on the left of the CPU.
2.	Connect the communication module to the OCI412.10	RS-485 pin 3 = Data + = X20.3 on OCI412.10 RS-485 pin 5 = GND = X20.1 on OCI412.10 RS-485 pin 8 = Data - = X20.2 on OCI412.10
3.	Connect the OCI412.10 to the burner control	RJ11 jack pin 1 = +5 V DC = X10 pin 1 on OCI412.10 RJ11 jack pin 2 = TxD = X10 pin 3 on OCI412.10 RJ11 jack pin 3 = RxD = X10 pin 2 on OCI412.10 RJ11 jack pin 4 = GND = X10 pin 4 on OCI412.10  Please note! Pin 2 and pin 3 of RJ11 jack are cross-connected to X10 pin 2 and pin 3.
4.	Install the R1 terminating resistor on the OCI412.10	Switch the R1 switch at position 1 on the OCI412.10 to ON.
5.	Supply DC 24 V to the OCI412.10	GND = X20.4 on OCI412.10 +DC 24 V = X20.5 on OCI412.10

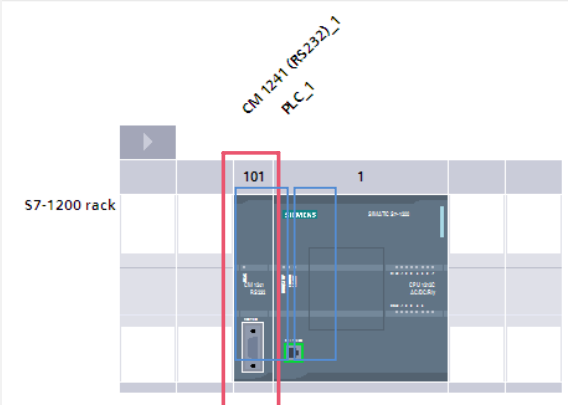
Table 4: Wiring the burner control connection

-  Note:
Observe the following supplementary documentation:
- LME39 Basic documentation (P7106)
 - LME7 Basic documentation (P7105)
 - LMO39 Basic documentation (P7154)
 - OCI412 Data sheet (N7615)

4.4 Hardware configuration and hardware installation of the SIMATIC S7-1200

No.	Action	Note
1	Launch TIA Portal V11	 <p>Double-click on the icon TIA Portal V11.</p>
2	Create a new project	<p>Menu Start → Create new project and confirm the project properties by clicking on Create.</p> 
3	Add the SIMATIC S7-1200 to be used	<p>Menu Devices & networks → Add new device. Select the PLC to be used based on the order no. by double-clicking on PLC → SIMATIC S7-1200 → CPU.</p> 

No.	Action	Note
4	Select the communication module to be used	<p>Menu Hardware catalog → Communications modules → Point-to-point.</p> <p>Select the communication module.</p> <p>For the burner control connection CM1241 (RS-485).</p> 

5	Integrate the selected communication module	<p>Move the selected communication module to its installation point on the left of the SIMATIC S7-1200 (drag and drop).</p> 
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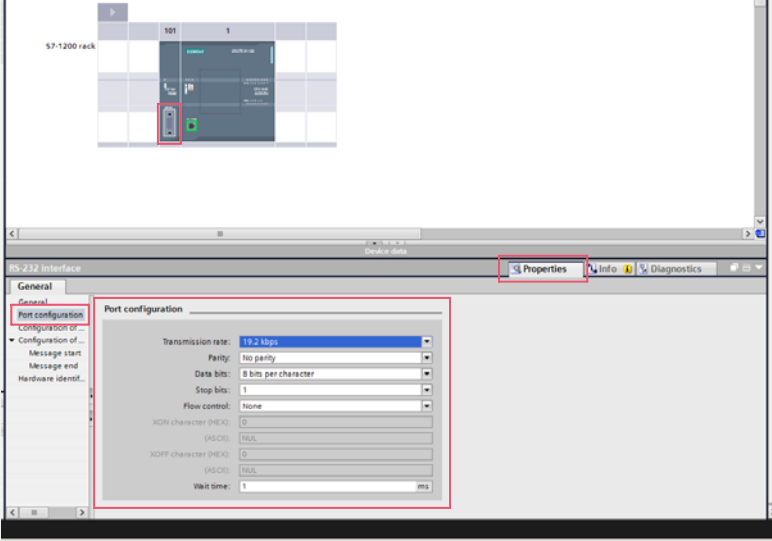
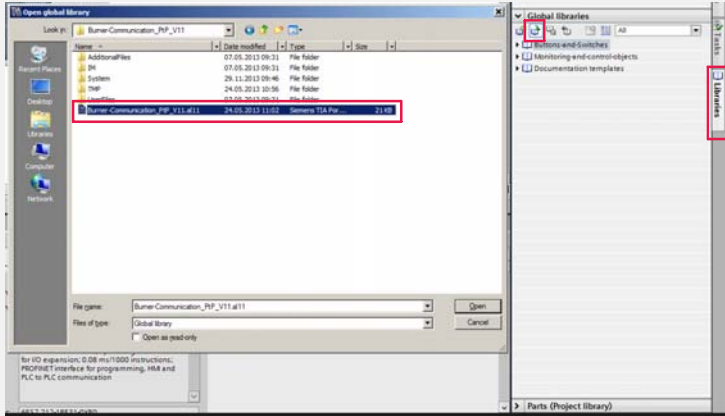
No.	Action	Note
6	<p>Set the port configuration:</p> <ul style="list-style-type: none"> • 19.2 kBaud • 8 data bits • No parity • 1 stop bit <p>Set up the configuration for the reception of messages:</p> <ul style="list-style-type: none"> • End of the message • Use message timeout to recognize the end of the message <input checked="" type="checkbox"/> • Message timeout 18...200 ms (Recommendation: approx. 80 ms) 	<p>Click on the port Properties → Port configuration. The transmission rate is 19.2 kBit/s. No parity bits, 8 data bits, and 1 stop bit are transmitted. There is no flow control.</p> 
7	Save the project	

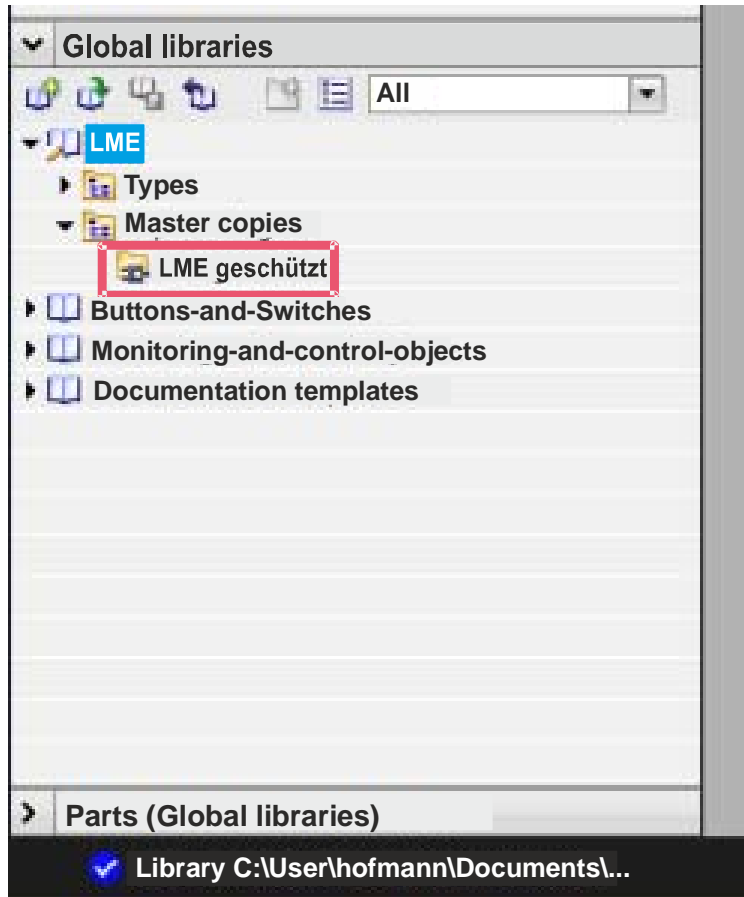
Table 5: Hardware configuration and hardware installation of the SIMATIC S7-1200

4.5 Installing the *Burner-Communication_PtP_V1x* libraries

No.	Action	Note
1	Unzip the <i>Burner-Communication.zip</i> file	Use a suitable program to unzip the file (WinZip / WinRAR). Take note of the folder in which the library is unzipped.
2	Open the unzipped library in TIA Portal	Open tools Libraries → Global libraries . Browse to the folder and open the library
		<p>TIA Portal V11 <i>LME.al11</i></p> <p>TIA Portal V12 SP1 <i>Burner-Communication_V12_SP1.al12</i> for PtP connections</p> <p>TIA Portal V13 <i>Burner-Communication_V13.al13</i> for PtP connections</p> 
3	Copy the required module into your project	Move the required modules from the library <i>Templates</i> to the <i>System blocks</i> folder of your project. For a point-to-point connection , only the required driver module is needed.

4.6 Only LME39 / LME7: Overview of the driver modules

(Name) driver component	Note
Following program components are available as a template	
TIA Portal V11	
• For a point-to-point connection	
LME-protected	For LME3 burner controls and LME7 burner controls



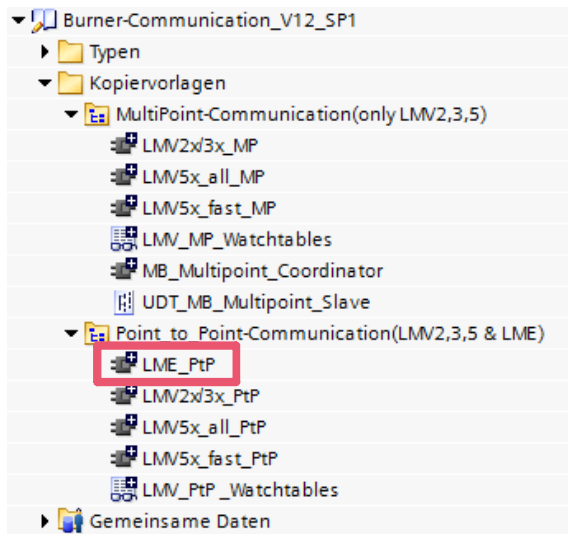
Caution!
Only the *LME-protected* library can be selected!

(Name) driver component	Note
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TIA Portal V12 SP1

- For a point-to-point (PtP) connection

LME_PtP	For LME3 burner controls and LME7 burner controls
---------	---



Caution!
Only the LME_PTP library can be selected!

(Name) driver component	Note
TIA Portal V13	
<ul style="list-style-type: none"> For a point-to-point (PtP) connection with S7-12000 CPU's 	
LME_PtP (Firmware 2.0-3.0)	For LME3 burner controls and LME7 burner controls (S7-1200 CPU with firmware 2.0-3.0)
LME_PtP (Firmware 4.0)	For LME3 burner controls and LME7 burner controls (S7-1200 CPU with firmware 4.0)
<ul style="list-style-type: none"> For a point-to-point (PtP) connection with S7-1500 CPU's 	
LME_PtP (Firmware 1.5-1.6)	For LME3 burner controls and LME7 burner controls (S7-1500 CPU with firmware 1.5-1.6)

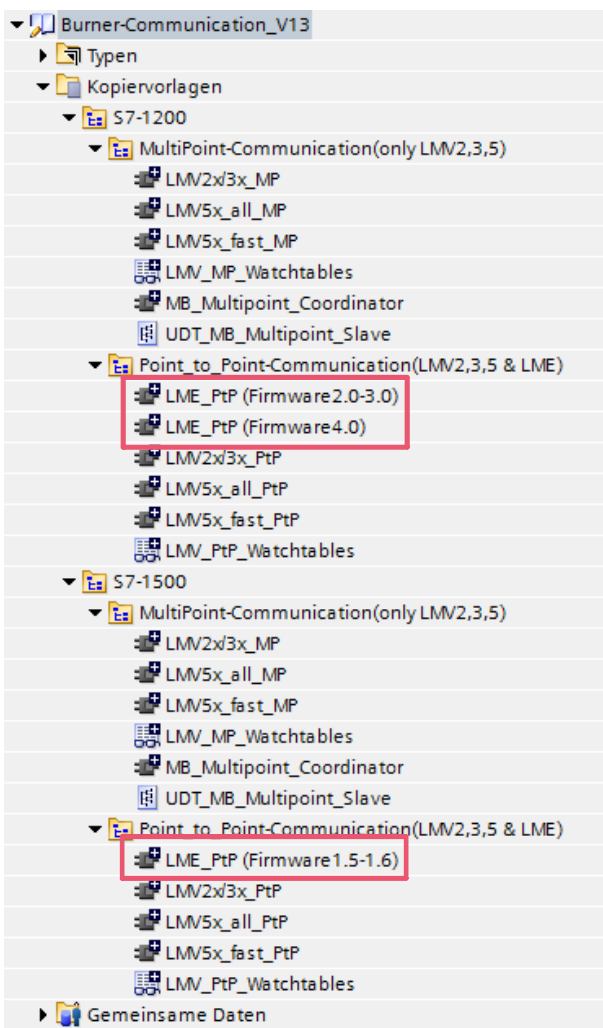


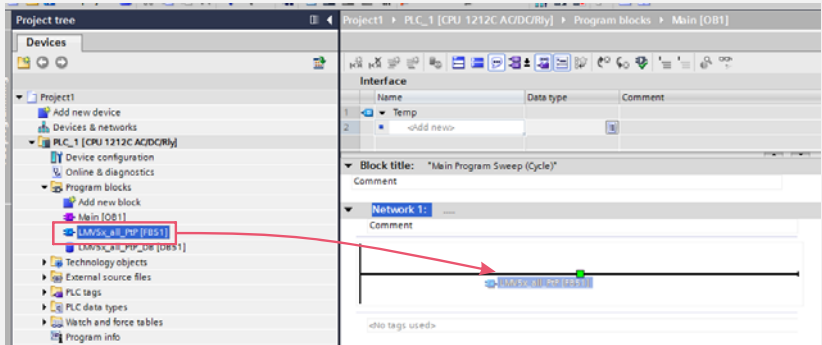
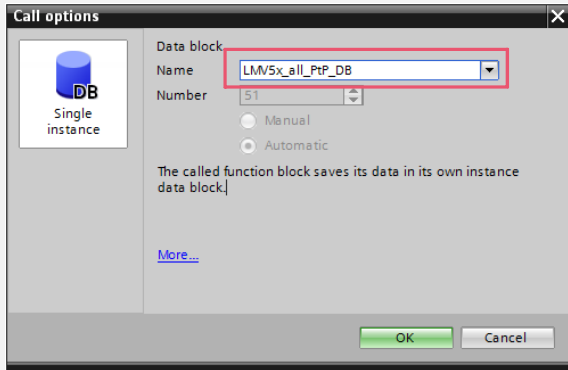
Table 6: Installation of the *Burner-Communication* library



Caution!
Only the LME_PTP libraries can be selected!

5 Commissioning the application

5.1 Preparing a point-to-point connection

No.	Action	Note
1	Call up the driver module in OB1	Move the required driver module (example: LME_PtP_DB) from the project to the open organization module Main [OB1] . 
2	Enter the name of the instance data module	Enter the name LME_PtP_DB in the window that opens for the second module to be copied. 

No.	Action	Note
3	Supply the inputs of the driver module with power	<p><i>COM_RST</i> requires a signal which indicates that communication has been restarted.</p> <p>Manual entry with a switch at input 0.0.</p> <p>For <i>COM-RST</i>, enter the value %I0.0.</p> <p>For <i>PORT_NR</i>, enter the name of the communication module used for communication.</p> <p>This name can be viewed in the device configuration.</p>

▼ **Block title:** "Main Program Sweep (Cycle)"

Comment

▶ **Network 1:**

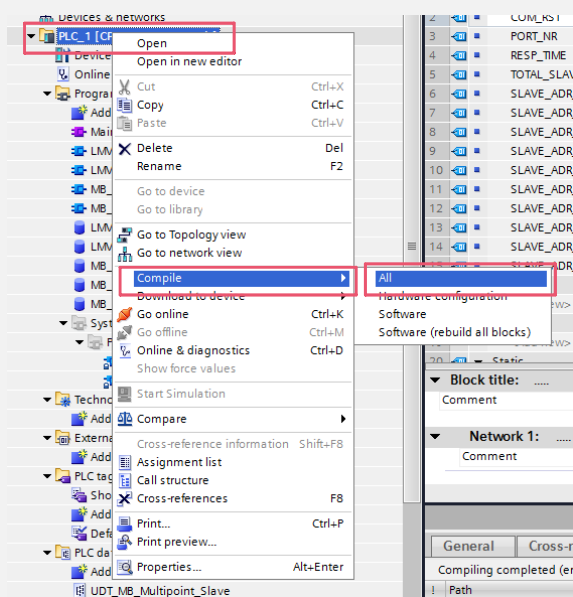

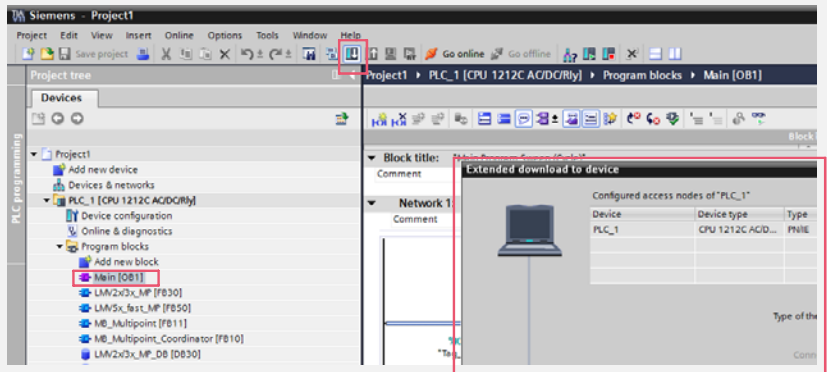
▶ **Network 2:**

▼ **Network 3:**

Comment

Table 7: Commissioning the application - preparation

5.2 Commissioning

No.	Action	Note
1	Compile the project part	<p>Right-click on the S7-1200 CPU and click on Compile → All</p> 
		<p> Note: If you obtain several errors during compilation, first attempt to recompile the project.</p>
2	Load the program into SIMATIC S7-1200	<p>Select the SIMATIC S7-1200 being used in the project tree and start to load the program by clicking on Download to device. Configure your access method for the SIMATIC S7-1200 in the Extended download to device window.</p> 

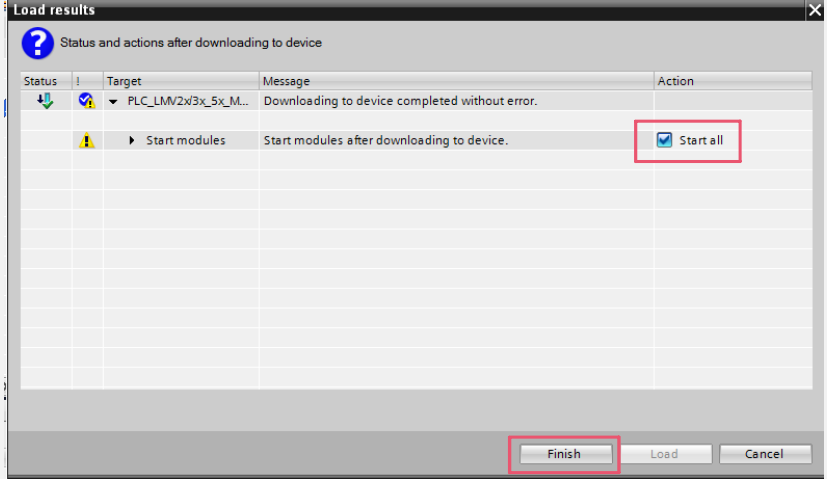

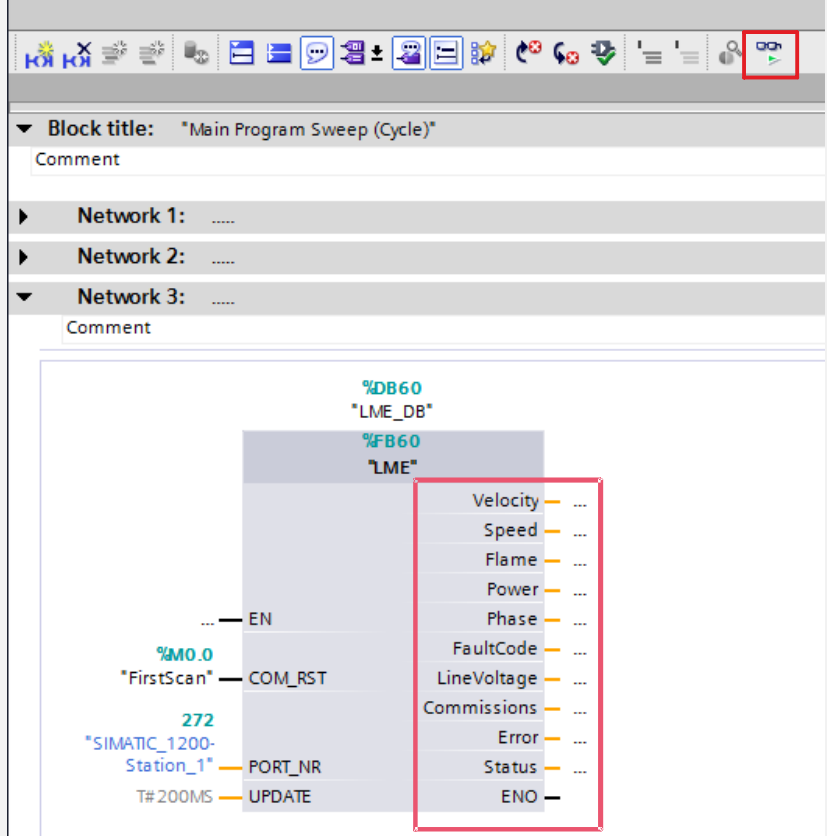
No.	Action	Note
3	Launch the SIMATIC S7-1200	<p>After the program has loaded, click on Start all and then on Finish.</p> 
4	Monitor and check the function block outputs	<p>Once <i>COM_RST</i> has received a signal, open Main[OB1] for a point-to-point connection.</p>  <p>Click on on/off.</p> 

Table 8: Commissioning the application - commissioning

6 Further information, tips, and tricks

- The *COM_RST* input variable can be triggered automatically in the first cycle of the PLC. Open startup organization module OB100 in your program and set an auxiliary variable of the *Bool* data type. Then connect *COM_RST* using this auxiliary variable. This auxiliary variable is only ON for the first cycle and must be reset at the end of OB1.



Note!

This variable is called *FristScan* in the sample project.

- By evaluating the outputs of the *fMB_Comm* function in the data module, it is possible to generate a process that monitors the communication status of the connection. In the event that communication with the burner control times out, the status *80C8* is output.
- An error and fault history can be created by storing the current error codes and fault codes in an overflow buffer.

7 Variable information

LME / LMO	SPS				Description
Data designation (parameter number)	Simatic S7-1200 variable name	Filing location in IDB	Data type	Type of access	Display
Speed	Velocity	Output	INT	R	Only LME7: → 0..65535 rpm Fan is connected, display of current PWM fan speed → -1 Without fan
Standardized speed (parameter 936)	Speed	Output	REAL	R	Only LME7: → 0..100% Fan is connected, display of the relative PWM fan speed → -1 Without fan
Flame intensity (parameter 954)	Flame	Output	REAL	R	→ $\mu\text{A}/\%$ Current flame signal, display value depending on burner control
Active power (parameter 140.04)	Power	Output	INT	R	Only LME7: → 0..100% Relative position of the actuator with modulation via analog signal
Program phase (parameter 140.01)	Phase	Output	BYTE	R	→ 0..99 Current MMI phase
Error code (parameter 701.00)	FaultCode	Output	BYTE	R	→ 0..255 Current error code / lock code
Mains voltage (parameter 951)	LineVoltage	Output	REAL	R	→ V Approximate, current mains voltage
Number of total startups (parameter 166)	Commissions	Output	DINT	R	Number of startups of the burner control
	Error	Output	DWORD	R	→ Array of 4 bytes Current internal error code of the burner control
	Status	Output	DWORD	R	→ Bit coded Query → current values are valid?

Table 9: Variable information

Note:

The tables contain the BC interface data points.

The documentation apply at all times ...:

- ... Data sheet
 - LME39 (N7106)
 - LME7 (N7105)
 - LMO39 (N7154)
- ... Basic documentation
 - LME39 (P7106)
 - LME7 (P7541)
 - LMO39 (P7154)
- ... User manual
 - PME71.111... (A7105.1)
 - PME71.112... (A7105.2)
 - PME71.401... (A7105.3)
 - PME71.402... (A7105.4)
 - PME71.901... (A7105.5)
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 - PME73.830... (A7105.25)
 - PME73.831... (A7105.26)
 - PME73.840... (A7105.27)



The basic unit documentation also applies with respect to error code lists, and phase numbers.

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