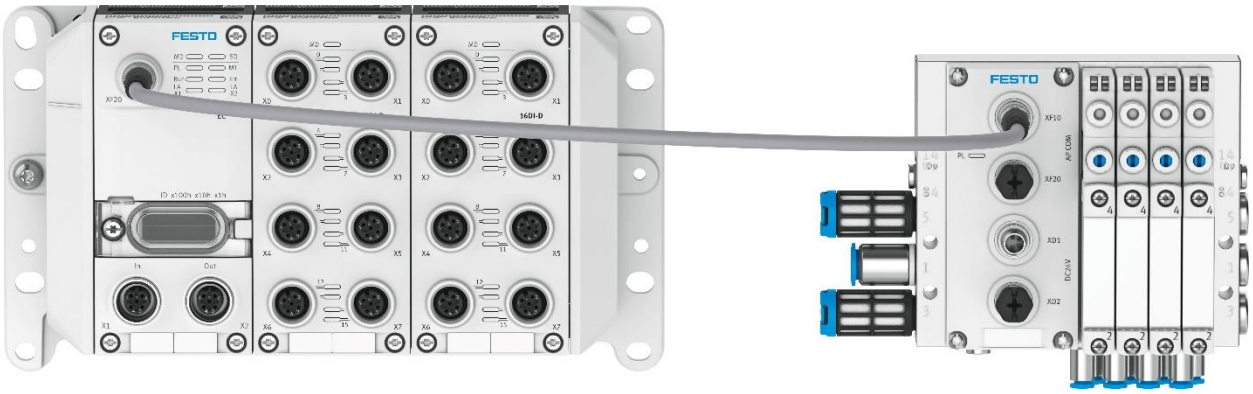
InoProShop 环境下 EtherCAT 控制 CPX-AP-A-EC&VTUG-AP



陆子强
Festo 技术支持
2023 年 8 月 15 日

关键词:
InoProShop，Inovance，EtherCAT，CPX-AP-A-EC , IO-LINK , VAEM-L1-S-**-AP

摘要：
本文介绍了使用 Inovance-AM401-CPU1608TP PLC 控制 Festo CPX-AP-A-EC 的实例，通讯协议为 EtherCAT，PLC 编程软件为 InoProShop。文档主要内容包括 CPX-AP-A-EC 模块硬件介绍，InoProShop 软件调试步骤介绍，festo lib 库使用及在线诊断功能介绍等。

目标群体：
本文仅针对有一定自动化设备调试基础的工程师，需要对 Festo AP 系统及汇川 PLC 有一定了解。

声明：
本文档为技术工程师根据官方资料和测试结果编写，旨在指导用户快速上手使用 Festo 产品，如果发现描述与官方正式出版物冲突，请以正式出版物为准。
我们尽量罗列了实验室测试的软、硬件环境，但现场设备型号可能不同，软件/固件版本可能有差异，请务必在理解文档内容和确保安全的前提下执行测试。
我们会持续更正和更新文档内容，恕不另行通知。

目录

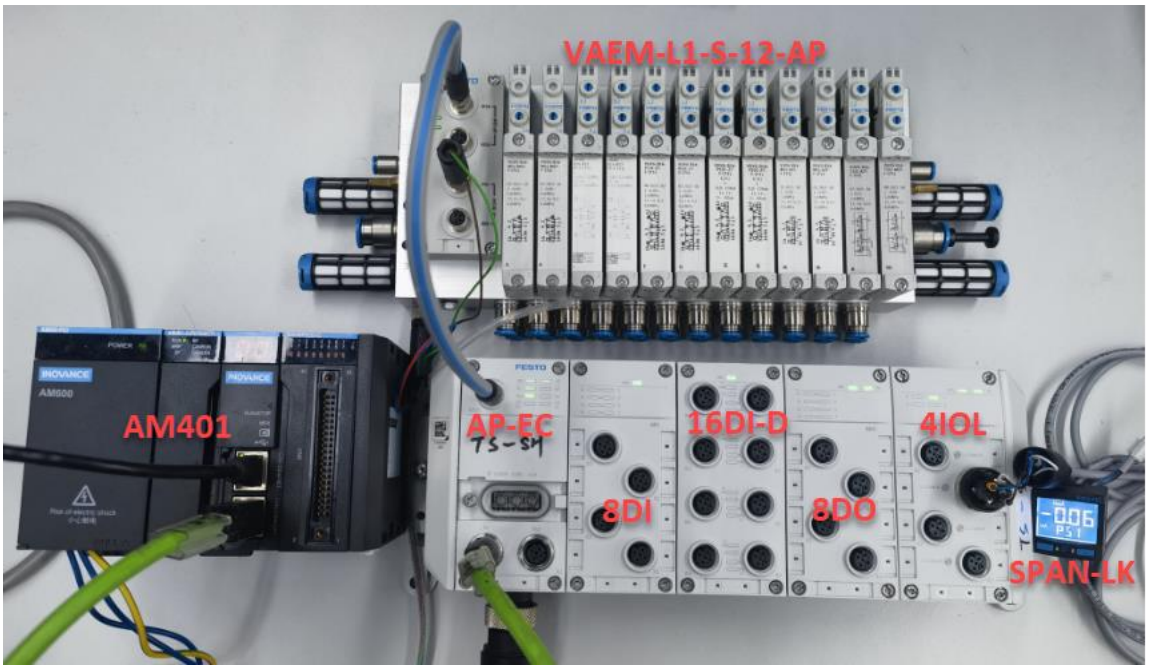
1 软件环境

软件	版本
InoProShop	V1.7.3-SP1
Festo Automation Suite	V2.6.0.481
Library	V1.3
ESI	Festo-CPX-AP-A-EC-20230421

2 硬件环境及实物

本次测试使用的硬件实物及型号如下：

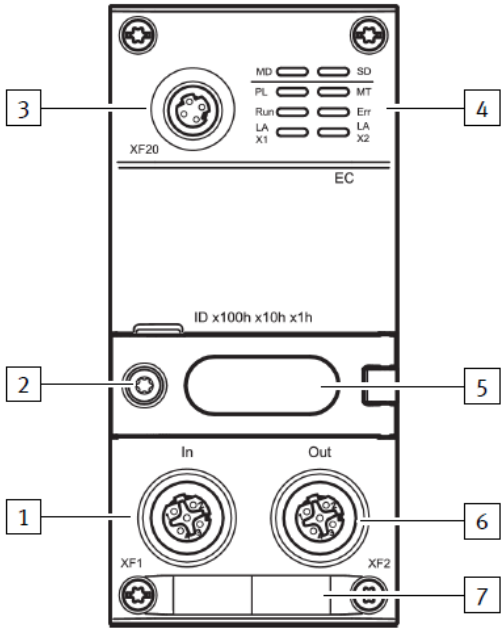
硬件型号	订货号	固件版本
CPX-AP-A-EC-M12	8129243	V1.5.33
CPX-AP-A-8DI-M12-5P	8129109	V1.100
CPX-AP-A-16DI-D-M12-5P	8129112	V1.100
CPX-AP-A-8DO-M12-5P	8129110	V1.100
CPX-AP-A-4IOL-M12	8129114	V1.5.6
VAEM-L1-S-12-AP	8081922	V1.100
SPAN-B2R-Q4-PNLK-PNVBA-L1	8035542	-
AM401-CPU1608TP	-	V3.5.9.40



2.1 硬件接口说明

2.1.1 CPX-AP-A-EC-M12 硬件接口说明

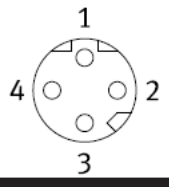
4.2.1 Product design



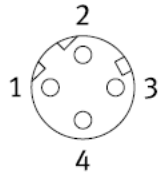
1 EtherCAT network connection [In XF2]
2 Rotary switch screw cover
3 Connection for system communication [XF20]
4 LED display
5 Rotary switch cover
6 EtherCAT network connection [Out XF2]
7 Inscription label

Fig. 1: Product design

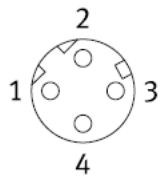
AP 系统通讯接口[XF20]（**必须使用** Festo 专用 AP 通讯线缆 NEBC-D8G4-ES-**-N-S-D8G4-ET）

Connection for system communication [XF20]			
Socket M8, 4-pin, D-coded		Signal	
	1	RX–	Received data –
	2	TX+	Transmitted data +
	3	RX+	Received data +
	4	TX–	Transmitted data –

EtherCAT 通讯接口[IN XF1]

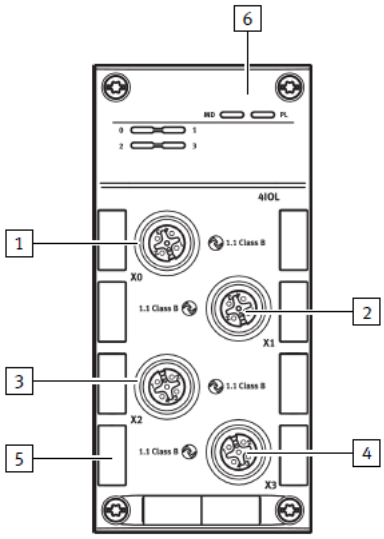
Connection for EtherCAT network [IN XF1]			
Socket M12, 4-pin, D-coded		Signal	
	1	TD+	Transmitted data +
	2	RD+	Received data +
	3	TD–	Transmitted data –
	4	RD–	Received data –
	Thread	Shield	Functional earth FE

EtherCAT 通讯接口[OUT XF2]

Connection for EtherCAT network [OUT XF2]			
Socket M12, 4-pin, D-coded		Signal	
	1	RD+	Received data +
	2	TD+	Transmitted data +
	3	RD–	Received data –
	4	TD–	Transmitted data –
	Thread	Shield	Functional earth FE

2.1.2 CPX-AP-A-4IOL-M12 硬件接口说明

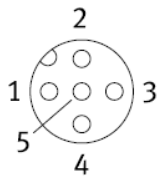
4.1 Product design



1 IO-Link port 0 [X0] connection
2 IO-Link port 1 [X1] connection
3 IO-Link port 2 [X2] connection
4 IO-Link port 3 [X3] connection
5 Inscription label (optional)
6 LED displays

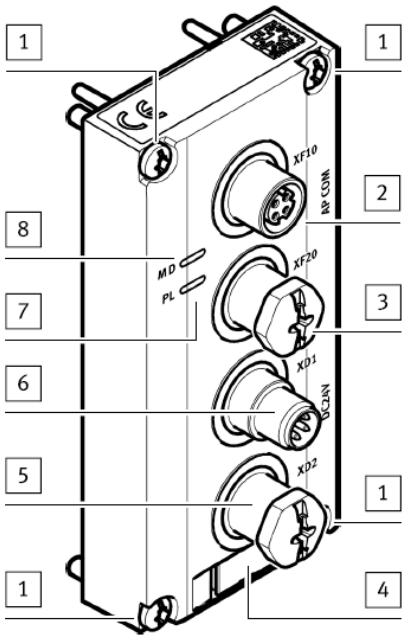
Fig. 1: Product design

IO-Link 通讯接口[X0...X3]

IO-Link Ports [X0] ... [X3] connection			
M12 socket, 5-pin, A-coded		Signal	
	1	L+	+24 V DC sensor supply
	2	P24	+24 V DC load voltage supply
	3	L–	0 V DC sensor supply
	4	C/Q	Standard IO (in SIO mode) or IO-Link communication (in IOL mode)
	5	N24	0 V DC load voltage supply

2.1.3 VAEM-L1-S-12-AP 硬件接口说明

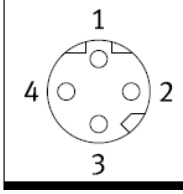
5.2.1 Product design



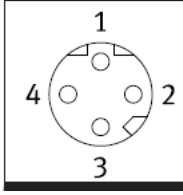
1 Retaining screw
2 Connection for system communication [XF10]
3 Connection for system communication forwarding [XF20]
4 Inscription label (optional)
5 Connection for voltage forwarding [XD2]
6 Connection for power supply [XD1]
7 LED load voltage [PL]
8 LED module diagnostics [MD]

Fig. 1 Product design

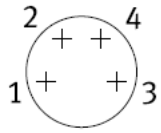
AP 系统通讯接口[XF10]（**必须使用** Festo 专用 AP 通讯线缆 NEBC-D8G4-ES-**-N-S-D8G4-ET）

Connection for system communication [XF10]			
Socket M8, 4-pin, D-coded		Signal	
	1	TX–	Transmitted data –
	2	RX+	Received data +
	3	TX+	Transmitted data +
	4	RX–	Received data –

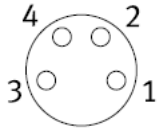
AP 系统通讯接口[XF20]（**必须使用** Festo 专用 AP 通讯线缆 NEBC-D8G4-ES-**-N-S-D8G4-ET）

Connection for system communication [XF20]			
Socket M8, 4-pin, D-coded		Signal	
	1	RX–	Received data –
	2	TX+	Transmitted data +
	3	RX+	Received data +
	4	TX–	Transmitted data –

电源接口[XD1]（可使用标准电缆 NEBL-M8G4-E-...-N-LE4 连接)

Connection for power supply [XD1]		
Plug M8, 4-pin, A-coded		Signal
	1	+24 V DC logic supply PS
	2	0 V DC load supply PL
	3	0 V DC logic supply PS
	4	+24 V DC load supply PL

电源接口[XD2]（可使用标准电缆 NEBL-M8G4-E-...-N-M8G4 连接下一个 AP 模块的 XD1 口）

Connection for voltage forwarding [XD2]		
Socket M8, 4-pin, A-coded		Signal
	1	+24 V DC logic supply PS
	2	0 V DC load supply PL
	3	0 V DC logic supply PS
	4	+24 V DC load supply PL

电源连接示意图：

7.1.1 Power supply concept

The automation system CPX-AP-I uses two separate voltages:
- Logic supply PS: power supply for the internal electronics and sensors
- Load supply PL: power supply for the electrical outputs and valves

The voltages can be supplied jointly by one fixed power supply or separately by two fixed power supplies.

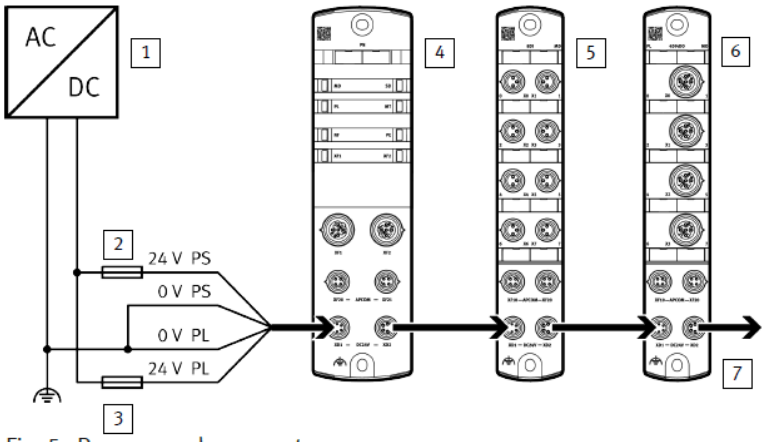


Fig. 5: Power supply concept

1 SELV/PELV fixed power supply
2 Fuse for line protection logic supply PS (max. 4 A)
3 Fuse for line protection load supply PL (max. 4 A)
4 Interface
5 Digital input module
6 Digital input/output module
7 Voltage forwarding (if necessary)

2.2 AP 系统拓扑结构

2.2.1 AP 系统地址映射说明

AP-A 系统总线节点上拥有一个[XF20]接口用于连接远程 IO 模块。通过接口 [XF10] 将连接电缆连接至各个远程 IO 模块。并可使用接口 [XF20] 转发至其他模块。
每次启动 CPX-AP 自动化系统时会自动分配模块地址。左侧第一个模块起始地址为 1，并按照先本地模块，再远程 IO 模块从左至右的安装顺序排序。

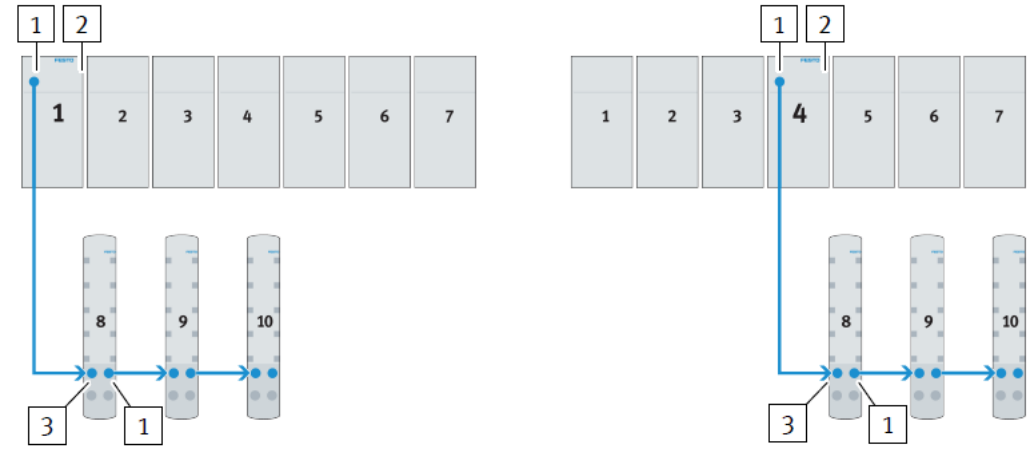
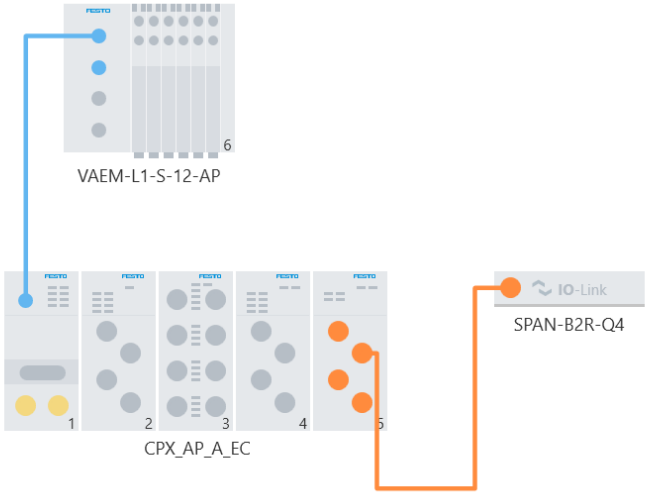


插图 13：系统通信和寻址

1 系统通信接口 [XF20]
2 接口
3 系统通信接口 [XF10]

2.2.2 本次案例地址说明



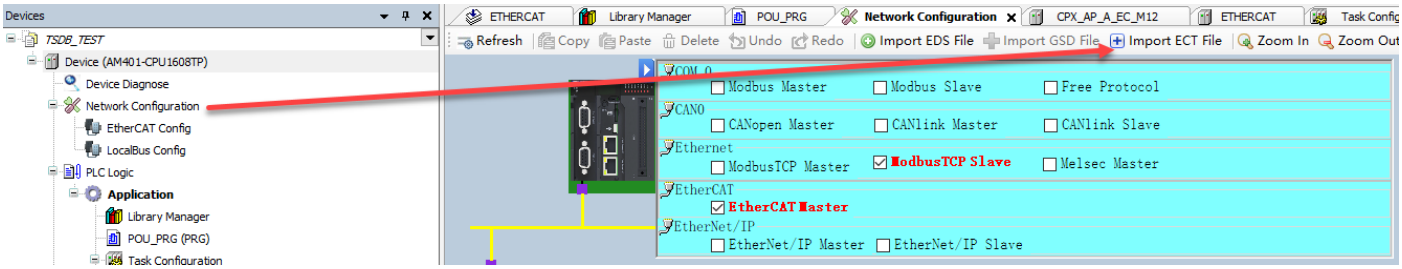
1 号为 CPX-AP-A-EC，2 号为 CPX-AP-A-8DI, 3 号为 CPX-AP-A-16DI-D，4 号为 CPX-AP-A-8D0,5 号为 CPX-AP-A-4IOL,6 号为 VTUG-AP 阀岛。IO-LINK 主站的 Port1 连接压力传感器 SPAN。

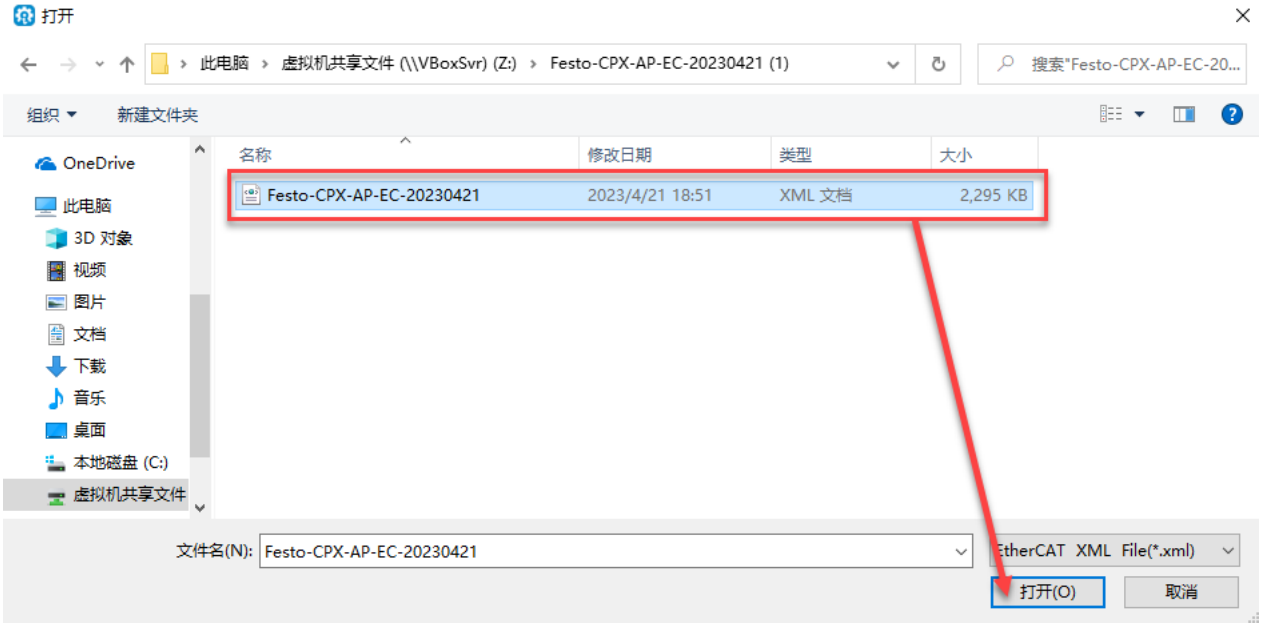
3 InoProShop 通讯调试

3.1 下载并安装 ESI 文件

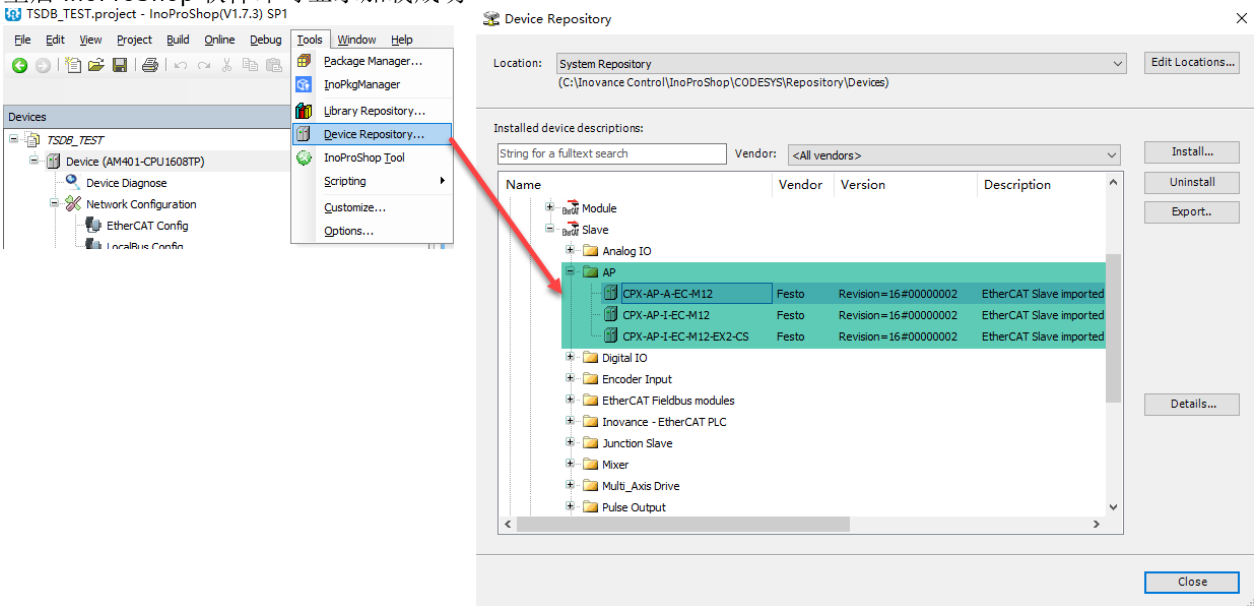
从 Festo 官网下载相应的 ESI 文件,链接如下：
https://www.festo.com.cn/cn/zh/search/?text=cpx-ap-a-ec&tab=DOWNLOADS&q=cpx-ap-a-ec

安装（导入）ESI 文件





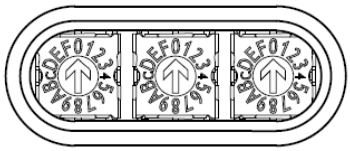
重启 InoProShop 软件即可显示加载成功



3.2 硬件及软件组态

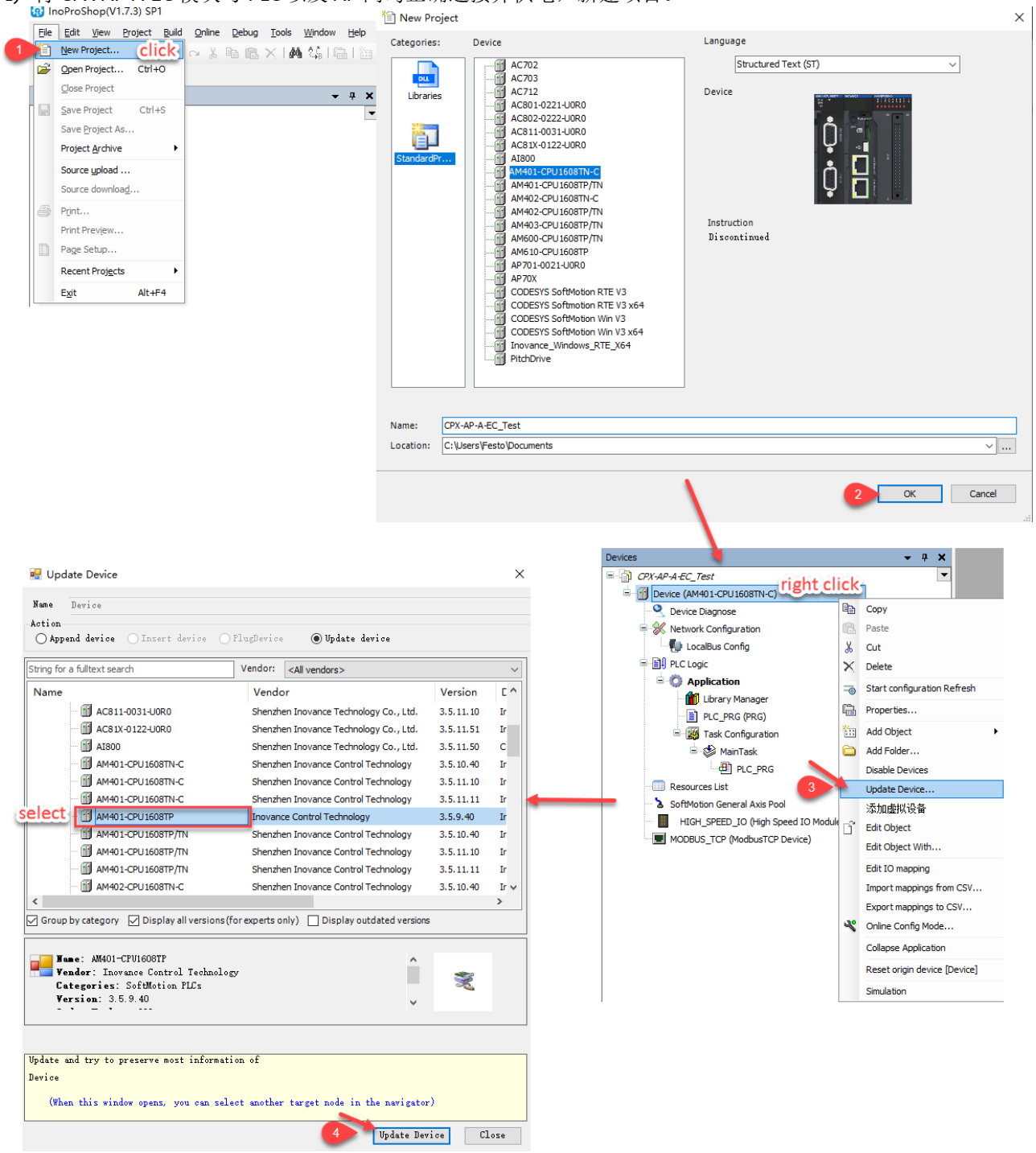
3.2.1 CPX-AP-A-EC 节点设置

1. DIL 旋钮设置固定地址，有效范围 1-4094。
2. DIL 旋钮设置 0，则通过 EtherCAT 主站来分配地址。

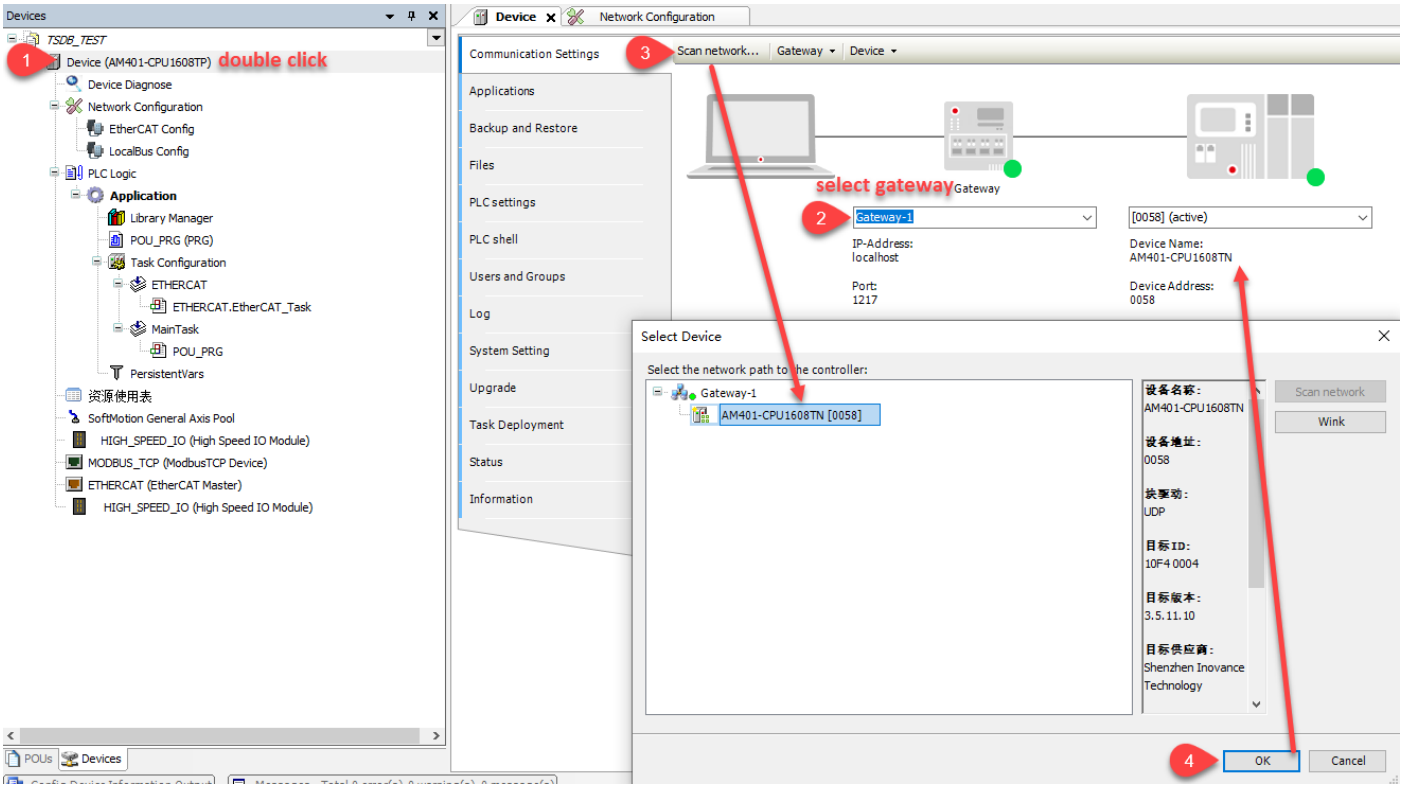
旋转开关	功能
IDx100hx10hx1h 	通过 3 个旋转开关设置十六进制编码的接口 EtherCAT "Explicit Device ID"。 可能的设置： – 0 = 保存的 EtherCAT 地址，未分配 “Explicit Device ID” – 1 … 4094 (1_h … fff_h) = 允许的地址范围 – 4095 (0xFFF) = 恢复至出厂设置 设置为 0 时，接口的地址通过 EtherCAT 主站自动分配（自动增量）。 出厂设置：0

3.2.2 硬件检测及程序下载

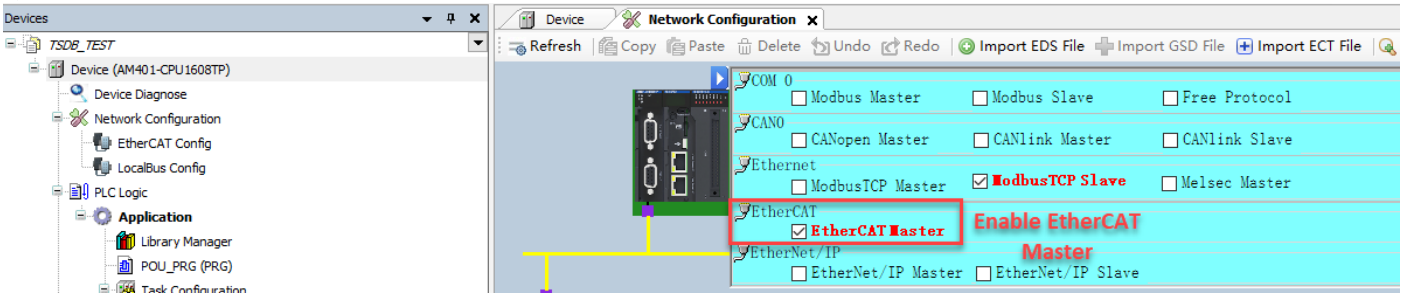
1) 将 CPX-AP-A-EC 模块与 PLC 以及 AP 阀岛正确连接并供电，新建项目。

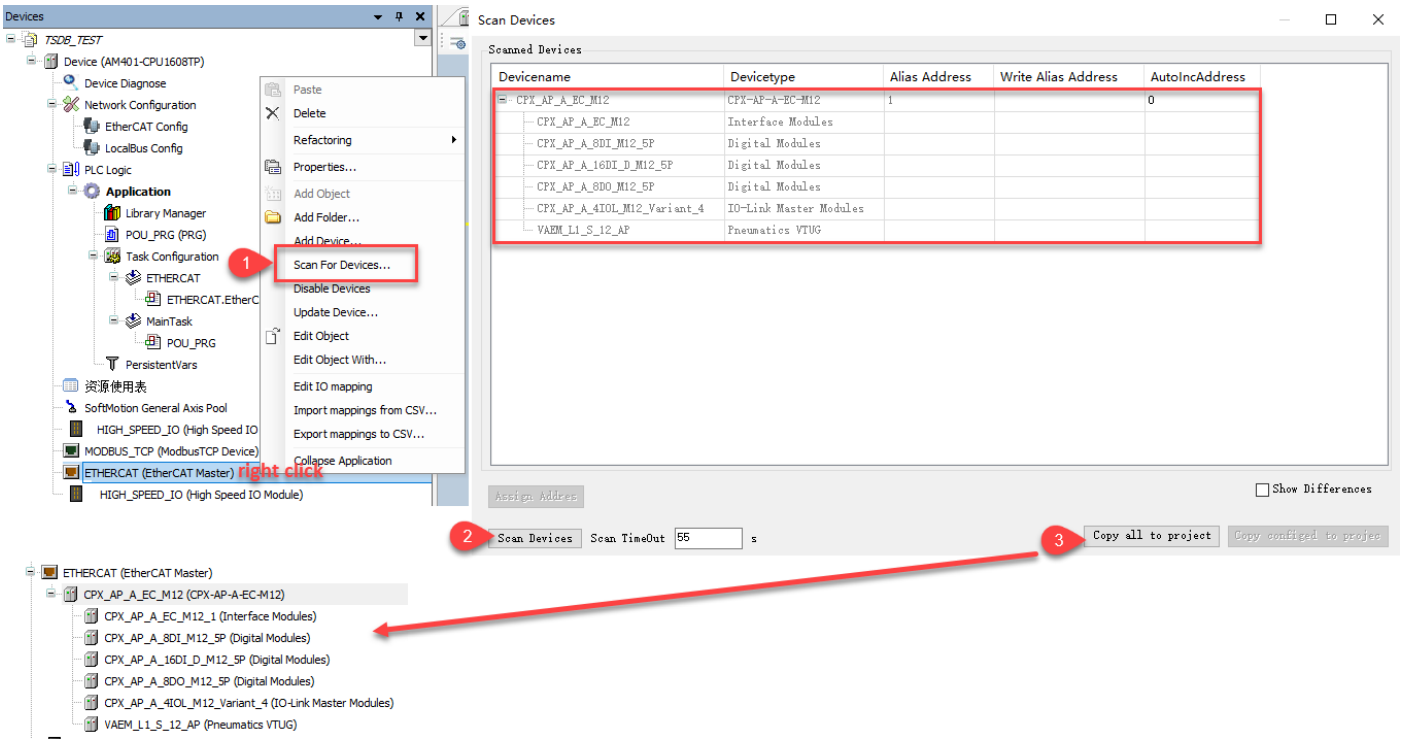


2) 连接 PLC，设置网关并自动扫描。

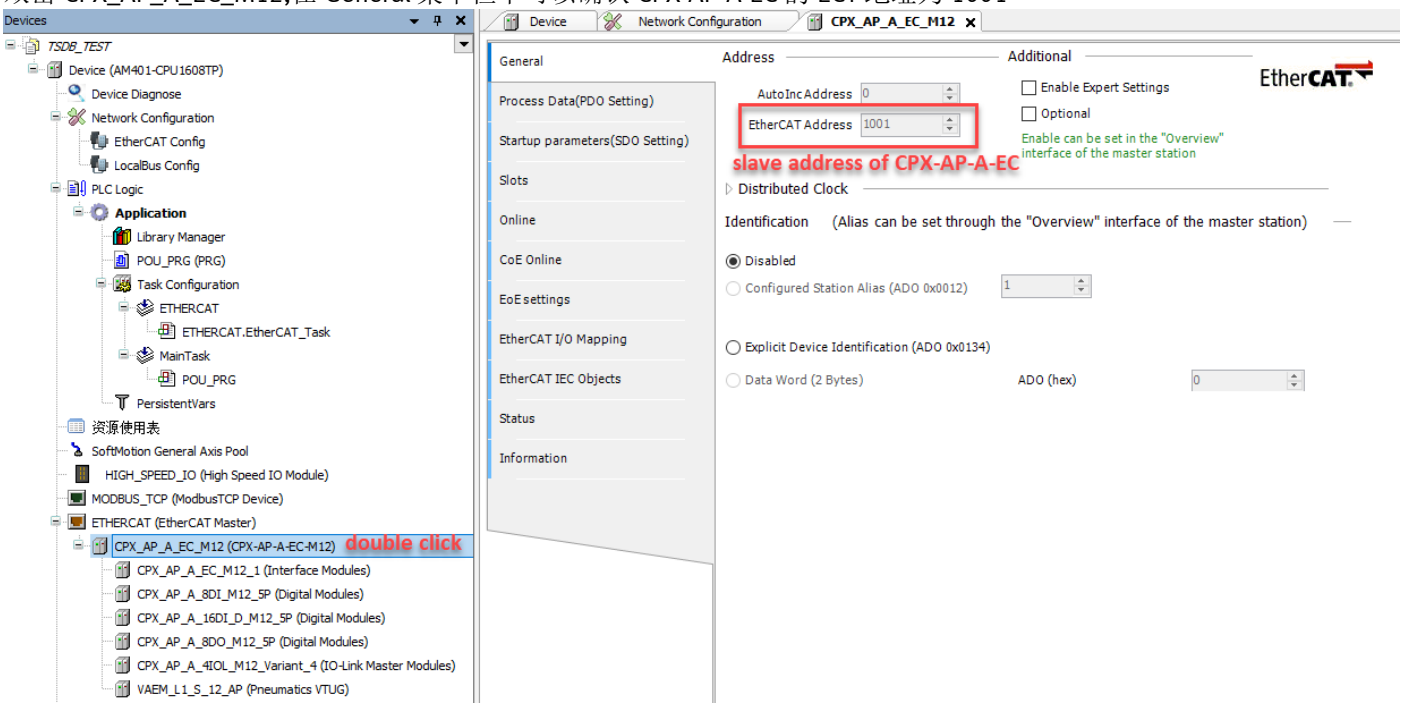


3) 在线扫描 EtherCAT 从站设备（本次案例设置 CPX-AP-A-EC 的 DIL 旋钮为 001）。



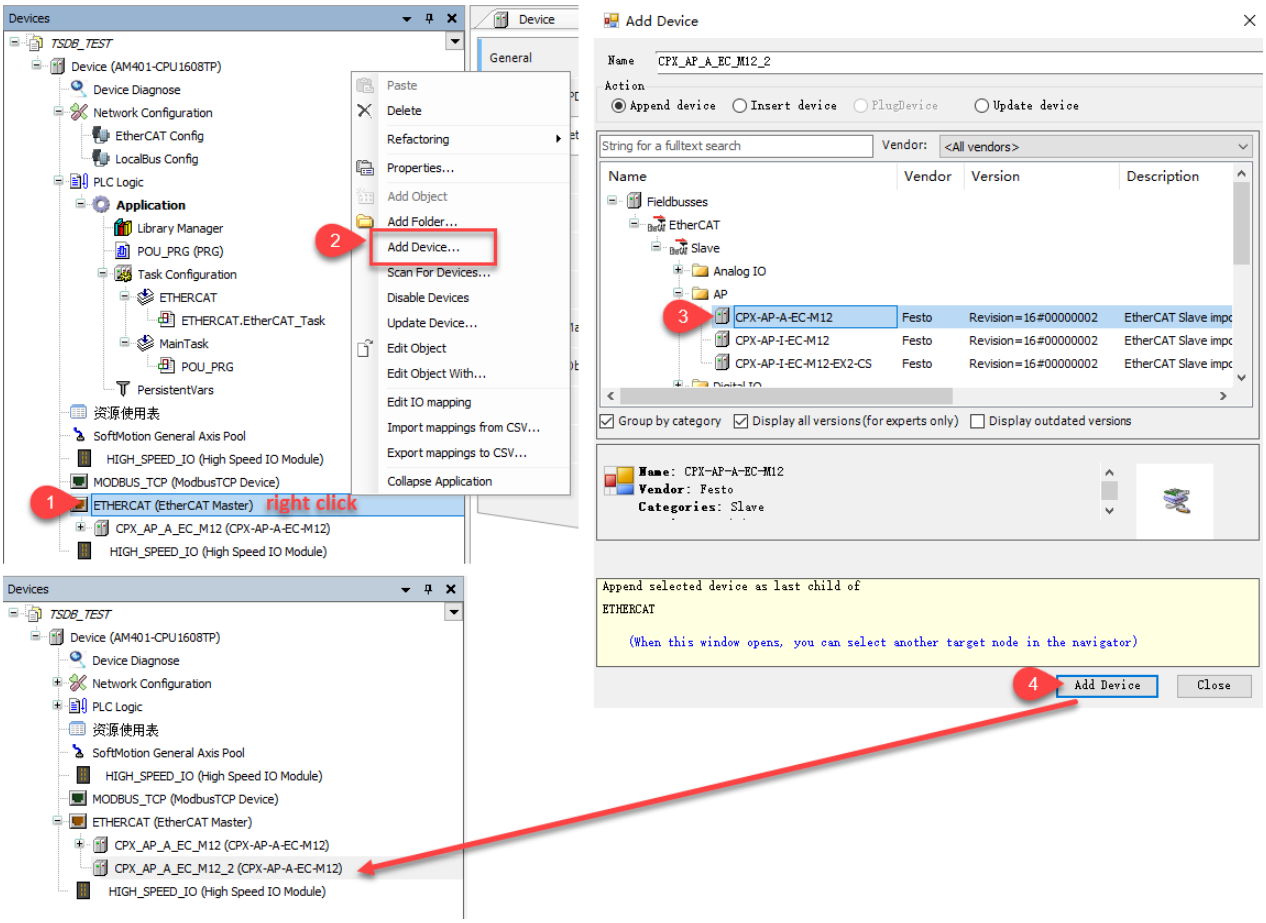


双击 CPX_AP_A_EC_M12,在 General 菜单栏中可以确认 CPX-AP-A-EC 的 ECT 地址为 1001

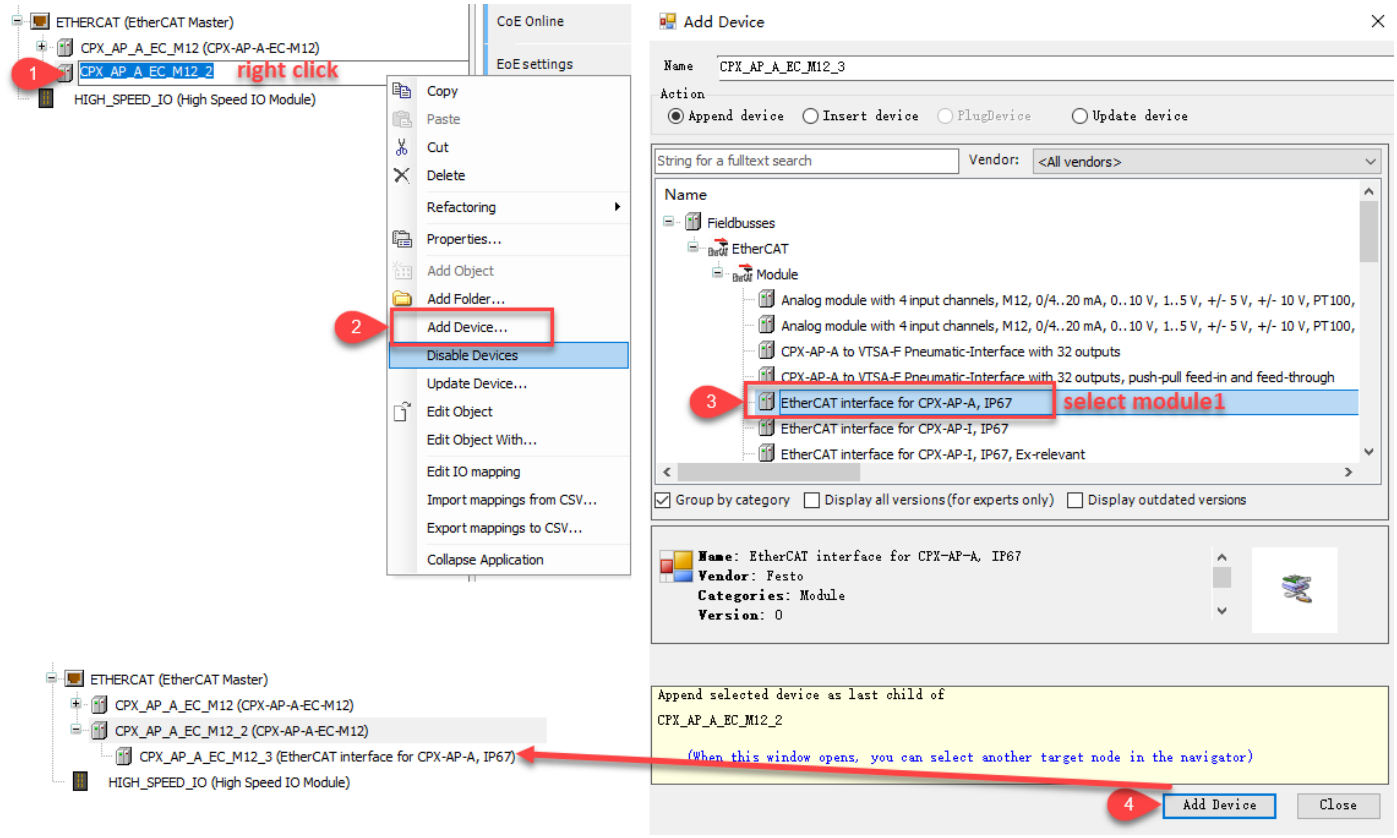


注意：如果无法在线扫描硬件组态可以通过右键 ETHERCAT（EtherCAT Master）自行离线添加，如下所示

1.添加 EC 从站类型为 AP

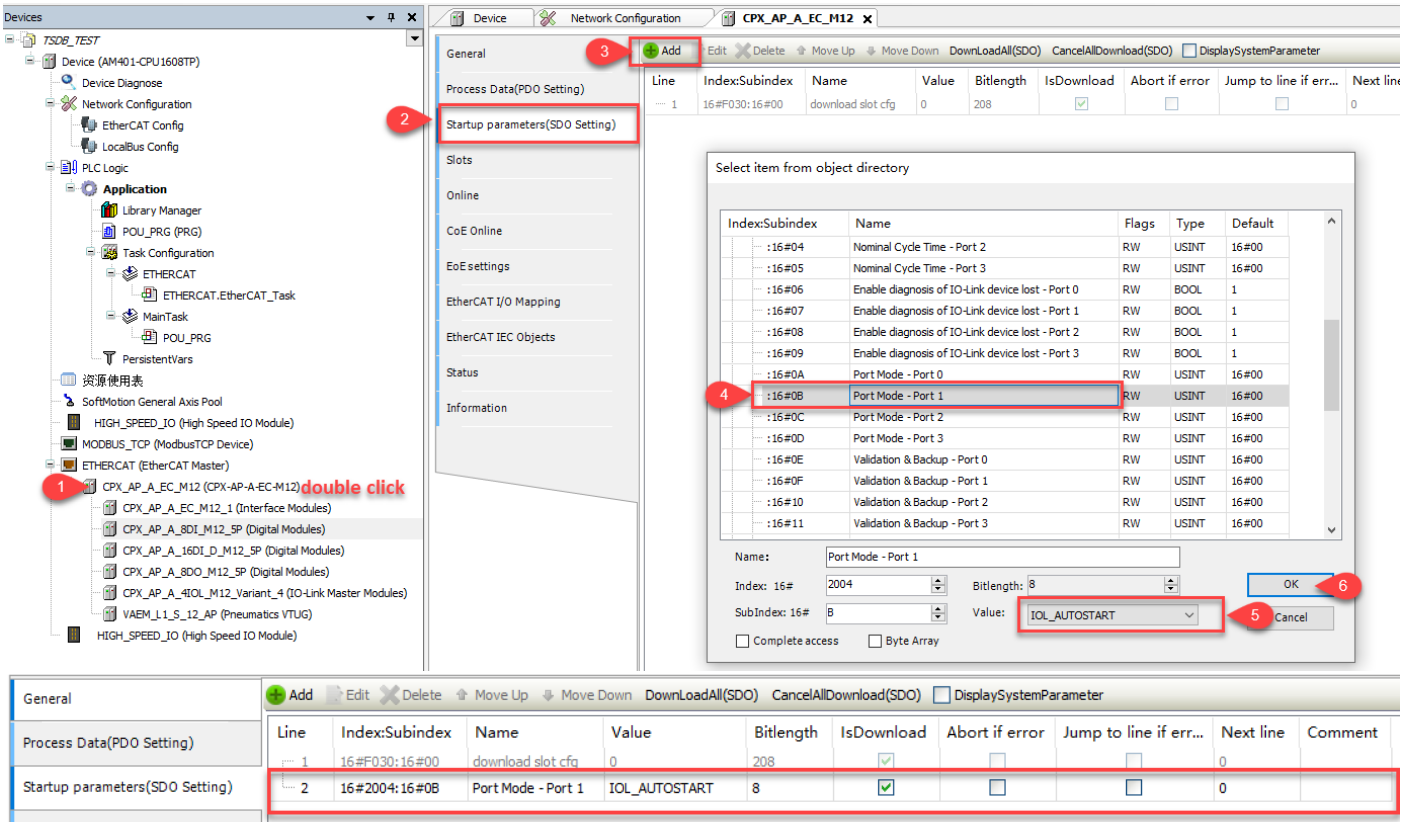


2.依次添加 AP 系统子模块

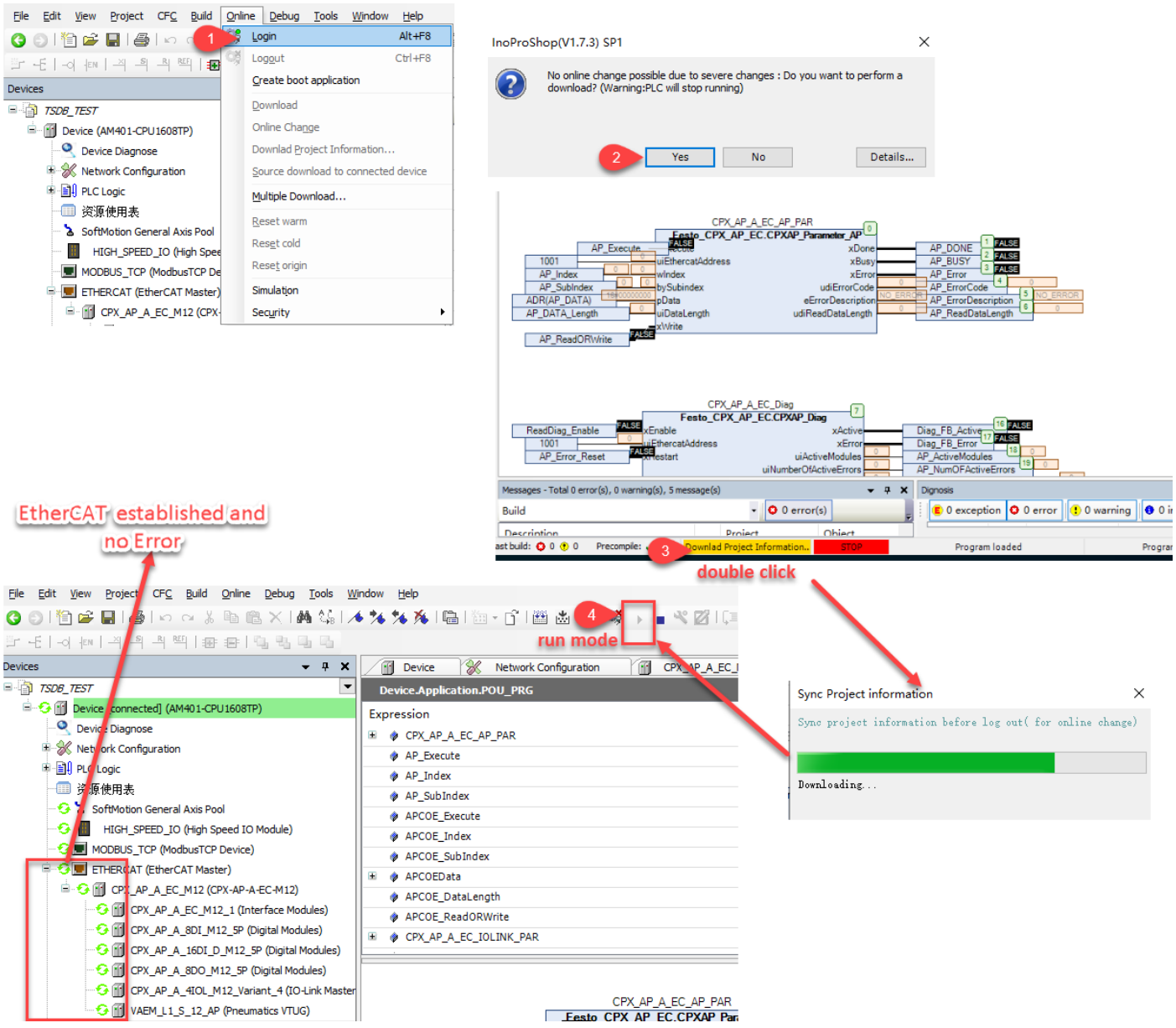


4) 添加启动参数并下载程序

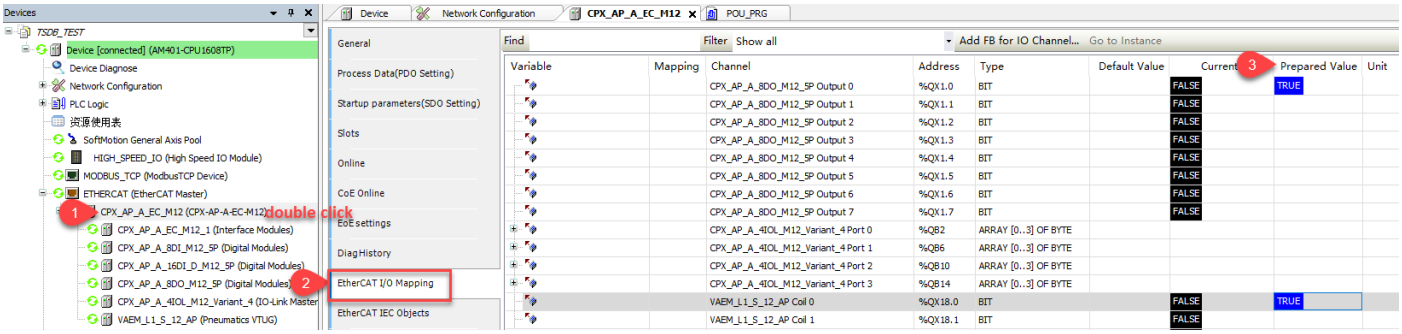
1.设置 CPX-AP-A-4IOL 的 Port 1 模式为 IOL_AUTOSTART

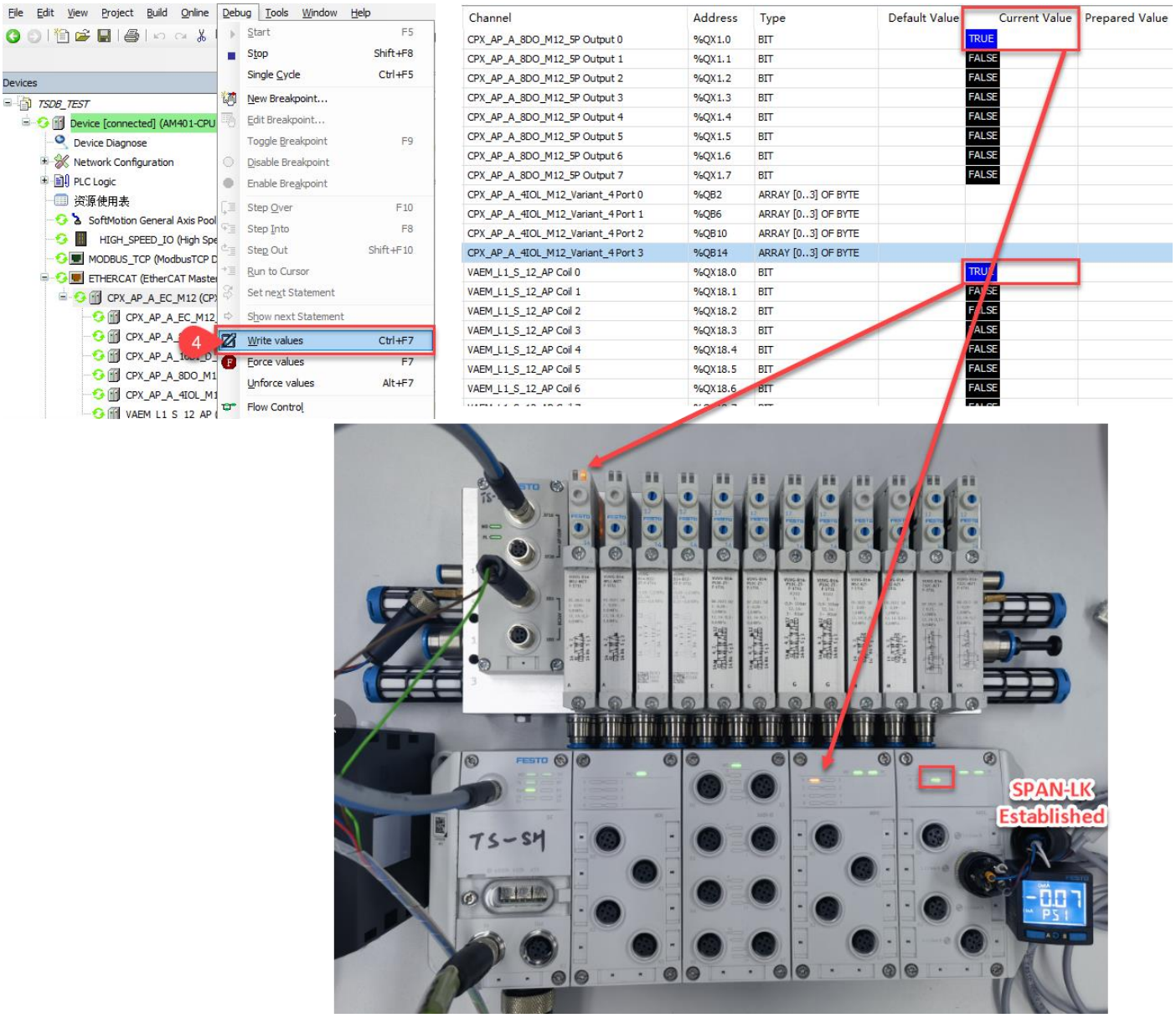


2.下载程序



3.2.3 I/O Mapping 测试控制输出



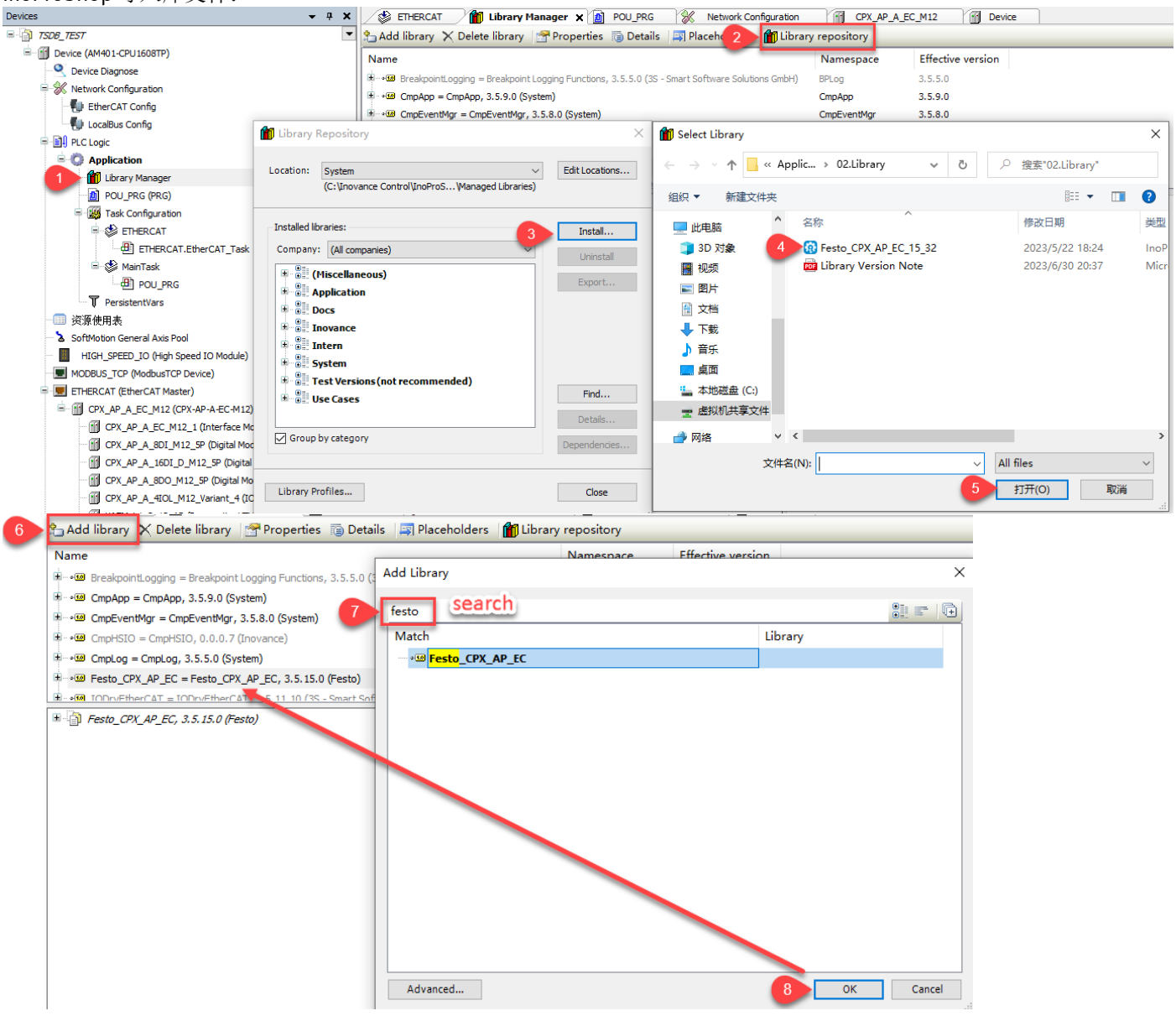


4 CPX-AP_Festo_Lib 库的使用

4.1 FB 库的下载及导入

从 Festo 官网下载对应的 Lib 库文件，下载链接如下：
https://www.festo.com.cn/cn/zh/search/?text=CPX-AP-A-EC&tab=DOWNLOADS&q=CPX-AP-A-EC

InoProShop 导入库文件：



4.2 FB 库的介绍

该库文件包含如下4个FB:

1. CPXAP_Parameter_AP
2. CPXAP_Parameter_CoE
3. CPXAP_IOLink_Parameter
4. CPXAP_Diag

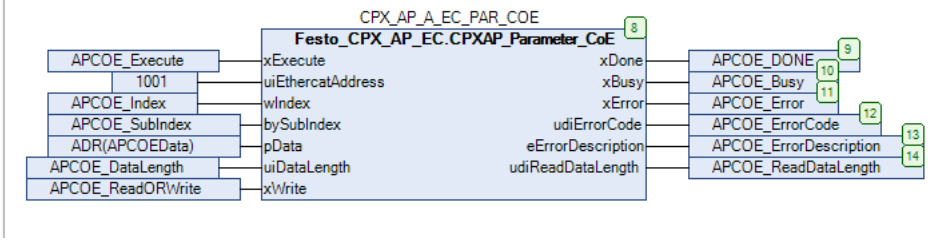
注：CPXAP_Parameter_AP 与 CPXAP_Parameter_CoE 功能一致，下文仅介绍CPXAP_Parameter_CoE。

4.2.1 CPXAP_Parameter_CoE

- 该功能允许用户读或写 CPX-AP-A/I-EC 系统模块的 COE 参数。
- 用户在同一时间仅可读或者写一个参数。
- Execute 上升沿有效。

CPXAP_Parameter_COE 功能块如下图所示：

	Scope	Name	Address	Data type	Initialization
38	VAR	**CPX_AP_A_EC_PAR_COE**		Festo_CPX_AP_EC.CPXAP_Parameter_CoE	
39	VAR	**APCOE_Execute**		BOOL	
40	VAR	**APCOE_Index**		WORD	
41	VAR	**APCOE_SubIndex**		BYTE	
42	VAR	**APCOEData**		POINTER TO BYTE	
43	VAR	**APCOE_DataLength**		UINT	
44	VAR	**APCOE_ReadORWrite**		BOOL	
45	VAR	**APCOE_DONE**		BOOL	
46	VAR	**APCOE_Busy**		BOOL	
47	VAR	**APCOE_Error**		BOOL	
48	VAR	**APCOE_ErrorCode**		UDINT	
49	VAR	**APCOE_ErrorDescription**		Festo_CPX_AP_EC.eSDOAbortCode	
50	VAR	**APCOE_ReadDataLength**		UDINT	



下表介绍了 FB 块的输入，输出变量的功能及数据类型。

输入变量

Name	DataType	Description
xExecute	BOOL	TRUE – Parameter Read/Write
uiEthercatAddress	UINT	Address of the slave device i.e. the address of the CPX-AP-I or CPX-AP-A module. Refer Chapter-3.2.2 for detailed description to find the uiEthercatAddress.
wIndex	WORD	Index of the Parameter which has to be Read or Written to.
bySubIndex	BYTE	Sub Index of the Parameter which has to be Read or Written to
uiDataLength	UINT	Number of Bytes of data to be Written using the Function Block.
xReadWrite	BOOL	FALSE – Read Parameter. TRUE – Write Parameter.
pData	POINTER TO BYTE	Variable to be Read/Written with the corresponding parameter Data Type. Example : If the User wants to read or write a parameter which is of the Data Type Integer, then a variable of the Data Type Integer must be linked to pData.

输出变量

Name	DataType	Description
xDone	BOOL	TRUE – Parameter Read or Write Finished.. FALSE- Parameter Read or Write not yet finished.
xBusy	BOOL	TRUE – Parameter Read or Write started. FALSE – Parameter Read or Write not yet started or it's completed.
xError	BOOL	TRUE – Parameter Read or Write has an error. FALSE – No error during Parameter Read or Write
udiErrorCode	UDINT	Error code of the Read or Write command executed
eErrorDescription	ENUM of the type eSDOAbortCode	Refer Table 4.2.1-1 for eSDOAbortCode values.
udiReadDataLength	UDINT	Number of bytes of data read during Parameter Read

eSDOAbortCode

Value	Description
16#0	NO_ERROR
16#5040004	CRC_ERROR
16#5040005	OUT_OF_MEMORY
16#6010000	UNSUPPORTED_ACCESS_TO_OBJECT
16#6010001	READ_NOT_ALLOWED
16#6010002	WRITE_NOT_ALLOWED
16#6020000	NO_SUCH_OBJECT
16#6040041	NOT_MAPPABLE
16#6040043	GENERAL_PARAM_INCOMPATIBILITY
16#6040047	GENERAL_INCOMPATIBILTY
16#6070010	LENGTH_DATA_INVALID
16#6090011	NO_SUCH_SUBINDEX
16#6090030	VALUE_RANGE_EXCEEDED
16#6090031	VALUE_TOO_LOW
16#6090032	VALUE_TOO_HIGH
16#8000021	LOCAL_CTRL_ERROR
16#8000022	DEVICE_STATE_ERROR
16#8000024	NO_DATA_AVAILABLE

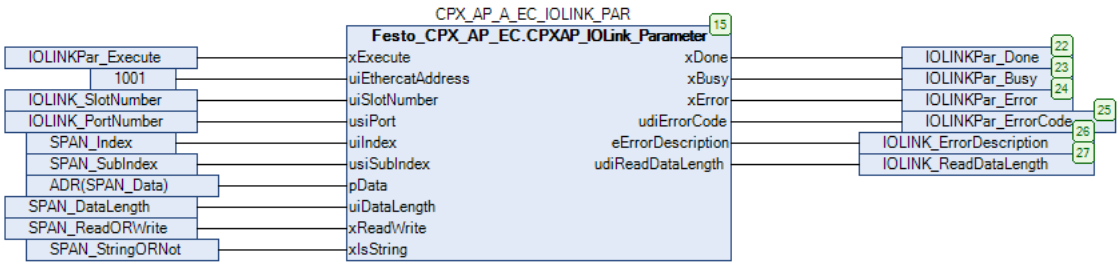
Table 4.2.1-1: eSDOAbortCode Values

4.2.2 CPXAP_IOLink_Parameter

- 该功能允许用户读或写连接在 CPX-AP-I/A-4IOL 模块上的 IO-LINK 设备的参数。
- 用户在同一时间仅可读或者写一个参数。
- Execute 上升沿有效。

CPXAP_IOLink_Parameter 功能块如下图所示：

	Scope	Name	Address	Data type	Initialization	Persistent	Constant
5	VAR	**CPX_AP_A_EC_IOLINK_PAR**		Festo_CPX_AP_EC.CPXAP_IOLink_Parameter		☐	☐
6	VAR	**IOLINKPar_Execute**		BOOL		☐	☐
7	VAR	**IOLink_SlotNumber**		UINT		☐	☐
8	VAR	**IOLINK_PortNumber**		USINT		☐	☐
9	VAR	**SPAN_Index**		UINT		☐	☐
10	VAR	**SPAN_SubIndex**		USINT		☐	☐
11	VAR	**SPAN_Data**		POINTER TO BYTE		☐	☐
12	VAR	**SPAN_DataLength**		UINT		☐	☐
13	VAR	**SPAN_ReadORWrite**		BOOL		☐	☐
14	VAR	**SPAN_StringORNot**		BOOL		☐	☐
15	VAR	**IOLINKPar_Done**		BOOL		☐	☐
16	VAR	**IOLINKPar_Busy**		BOOL		☐	☐
17	VAR	**IOLINKPar_Error**		BOOL		☐	☐
18	VAR	**IOLINKPar_ErrorCode**		UDINT		☐	☐
19	VAR	**IOLINK_ErrorDescription**		Festo_CPX_AP_EC.eIOLinkAbortCode		☐	☐
20	VAR	**IOLINK_ReadDataLength**		UDINT		☐	☐



下表介绍了 FB 块的输入，输出变量的功能及数据类型。

输入变量

Name	DataType	Description
xExecute	BOOL	TRUE – Parameter Read/Write
uiEthercatAddress	UINT	Address of the slave device i.e. the address of the CPX-AP-I or CPX-AP-A module. Refer Chapter-3.2.2 for detailed description to find the uiEthercatAddress.
uiSlotNumber	UINT	Slot of the CPX-AP-A-4IOL-M12 module where the IO link device is connected
usiPort	USINT	The port of the CPX-AP-A-4IOL IO Link Master module to which the IO Link de-vice is connected.
uiIndex	UINT	Index of the parameter of IO Link device. Refer IO Link device manual.
usiSubIndex	USINT	Sub Index of the parameter of IO Link device Refer IO Link device manual.
uiDataLength	UINT	Number of Bytes of data to be Written using the Function Block.
xReadWrite	BOOL	FALSE – Read Parameter. TRUE – Write Parameter.
xIsString	BOOL	TRUE- If the parameter data type is STRING. FALSE- If the parameter data type is not STRING.
pData	VARIANT	Variable to be Read/Written with the corresponding parameter Data Type. Example : If the User wants to read or write a parameter which is of the Data Type Integer, then a variable of the Data Type Integer must be linked to pData.

输出变量

Name	DataType	Description
xDone	BOOL	TRUE – Parameter Read or Write Finished.. FALSE- Parameter Read or Write not yet finished.
xBusy	BOOL	TRUE – Parameter Read or Write started. FALSE – Parameter Read or Write not yet started or it's completed.
xError	BOOL	TRUE – Parameter Read or Write has an error. FALSE – No error during Parameter Read or Write.
udiErrorCode	UDINT	Error code of the Read or Write command executed
eErrorDescription	ENUM of the Type eIOLinkAbortCode	Refer Table 4.2.2-1 for detailed description of eIOLink-AbortCode.
udiReadDataLength	UDINT	Number of bytes of data read during Parameter Read.

eIOLinkAbortCode

Value	Description
16#0	NO_ERROR
16#1000	MASTER_COMMUNICATION_ERROR
16#1100	MASTER_ISDU_TIMEOUT
16#5600	MASTER_ISDU_CHECKSUM_ERROR
16#8000	DEVICE_APPLICATION_ERROR_NO_DETAILS
16#8011	INDEX_NOT_AVAILABLE
16#8012	SUB_INDEX_NOT_AVAILABLE
16#8020	SERVICE_NOT_AVAILABLE
16#8023	INDEX_NOT_WRITEABLE
16#8030	PARAMETER_VALUE_OUT_OF_RANGE
16#8031	PARAMETER_VALUE_ABOVE_LIMIT
16#8032	PARAMETER_VALUE_BELOW_LIMIT
16#8033	PARAMETER_LENGTH_OVERRUN
16#8034	PARAMETER_LENGTH_UNDERRUN
16#8035	FUNCTION_NOT_AVAILABLE
16#8036	FUNCTION_TEMPORARY_UNAVAILABLE
16#8040	INVALID_PARAMETER_SET
16#8041	INCONSISTENT_PARAMETER_SET
16#8082	APPLICATION_NOT_READY
16#8100	VENDOR_UNSPECIFIC
16#999	VENDOR_SPECIFIC
16#6020000	WRONG_SLOT_NUMBER
16#80000	GENERAL_SDO_ERROR

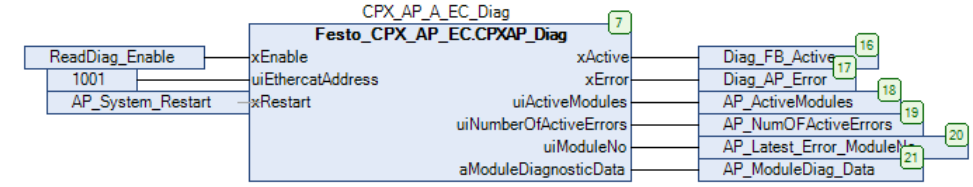
Table 4.2.2-1 eIOLinkAbortCode values

4.2.3 CPXAP_Diag

- 该功能允许用户读取 CPX-AP 系统上的模块诊断信息。诊断信息分类如下：
  1. 报警代码
  2. 发生报警的模块编号
  3. 发生报警的模块通道
  4. 报警类型
  5. 报警信息描述
- 用户可通过 xRestart 重启 CPX-AP 系统。

CPXAP_Diag 功能块如下图所示：

	Scope	Name	Address	Data type	Initialization
29	VAR	**CPX_AP_A_EC_Diag**		Festo_CPX_AP_EC.CPXAP_Diag	
30	VAR	**ReadDiag_Enable**		BOOL	
31	VAR	**AP_System_Restart**		BOOL	
32	VAR	**Diag_FB_Active**		BOOL	
33	VAR	**Diag_AP_Error**		BOOL	
34	VAR	**AP_ActiveModules**		UINT	
35	VAR	**AP_NumOFActiveErrors**		UINT	
36	VAR	**AP_Latest_Error_ModuleNo**		UINT	
37	VAR	**AP_ModuleDiag_Data**		ARRAY [1..150] OF Festo_CPX_AP_EC.stModuleDiagData	



下表介绍了 FB 块的输入，输出变量的功能及数据类型。

输入变量

Name	DataType	Description
xEnable	BOOL	TRUE – Continuously read diagnostic in-formation.
uiEthercatAddress	UINT	Address of the slave device i.e. the address of the CPX-AP-I or CPX-AP-A module. Refer Chapter-3.2.2 for detailed description to find the uiEthercatAddress.
xRestart	BOOL	TRUE = Restart the EtherCAT devices. The machine state changes from INIT >> PREOP >> SAFE >> OPERATIONAL.

输出变量

Name	DataType	Description
xActive	BOOL	TRUE = Connected EtherCAT device in Operation Mode. FALSE = Module is Disconnected from the device or Module not in Operation Mode.
xError	BOOL	TRUE = Error exist during Diagnosis block running. FALSE = Error is not exist during Diagnosis block run-ning.
uiActiveModules	UINT	Number of active modules connected.
uiNumberOfActiveErrors	UINT	Number of Modules having error.
uiModuleNo	UINT	Module having latest active diagnosis.
aModuleDiagnosticData	STRUCTURE of the type stModuleDiagData	Refer Table 4.2.3-1 for stModuleDiagData description

stModuleDiagData

Name	DataType	Description
udiModuleDiagState	UDINT	Info Message
uiActiveDiagnosisCount	UINT	Currently active diagnosis on the module.
uiSubModule	UINT	Sub Module entry of last diagnosis.
uiChannel	UINT	Channel entry of last diagnosis.
udiDiagnosisCode	UDINT	Diagnosis Code of last diagnosis.
eErrorDescription	ENUM of the Type eErrorDescription	Diagnosis Code description. Refer Table 4.2.3-2 for eErrorDescription.
xError	BOOL	TRUE = Module has an error.

Table 4.2.3-1 stModuleDiagType

eErrorDescription

Value	Description
0	NO_ERROR
16777644	CURRENT_SENSE_RESISTOR_OVERLOADED
16843019	SHORT_CIRCUIT_OVERLOAD_IN_SENSOR_SUPPLY
16843020	OUTPUT_SIGNAL_SHORT_CIRCUIT_OVERLOAD
16843105	SHORT_CIRCUIT_CHECK_INSTALLATION
16843106	EARTH_FAULT_CHECK_INSTALLATION
16843130	SHORT_CIRCUIT_ON_IQ
16843131	SHORT_CIRCUIT_ON_CQ
16843132	OVERLOAD_ON_IQ
16843133	OVERLOAD_ON_CQ
33619990	UNDERVOLTAGE_LOGIC_SUPPLY_PS
33619991	OVERVOLTAGE_LOAD_SUPPLY_PS
33620229	UNDERVOLTAGE_LOAD_SUPPLY_PL
33620230	SWITCH_OFF_LOAD_SUPPLY_PL
33620287	OVERVOLTAGE_LOAD_SUPPLY_PL
33620297	GENERAL_POWER_SUPPLY_ERROR
33882439	MEMORY_ERROR
33882440	BATTERIES_WEAK
50397229	TEMPERATURE_IN_DEVICE_TOO_LOW
50397231	DEVICE_OVERTEMPERATURE
50397506	TEMPERATURE_ERROR_OVERLOAD
50397569	PHY_OVERTEMPERATURE
100663561	START_UP_PARAMETER_REJECTED
100663562	START_UP_PARAMETER_DEVIATION_IN_LENGTH
100663631	PARAMETER_ERROR
100663632	PARAMETER_MISSING_IN_THE_DEVICE
100663688	MODULE_IDENTIFICATION_CHECK_SKIPPED
100663689	MODULE_IDENTIFICATION_CHECK_FAILED
100794678	HIGHER_THRESHOLD_EXCEEDED
100794679	LOWER_THRESHOLD_UNDERFLOW

Value	Description
100794680	VALUE_OUT_OF_RANGE
100991074	PARAMETER_SET_INVALID
117768550	MEASURING_RANGE_EXCEEDED
117899621	OVERFLOW_OF_THE_PROCESS_VARIABLE_RANGE
117899623	UNDERFLOW_OF_THE_PROCESS_VARIABLE_RANGE
134218030	DEVICE_ADDRESS_INVALID
134218130	INVALID_CYCLE_TIME
134283682	DEVICE_IN_EMERGENCY_OPERATION_SYSTEM_STATE
134283684	DEVICE_VARIANT_MISMATCH
134283693	SYSTEM_STATE_CHANGE_TO_OPERATION_FAILED
134283716	AP_MODULES_DETECTED
134283775	DEVICE_NOT_READY
134283797	DEVICE_FORCED_TO_COMMUNICATION_LOOPBACK
134283813	INVALID_TOPOLOGY
134318095	AP_PROCESS_DATA_INTERNAL_ERROR
134480273	STATUS_CHANGE_REQUEST
134480275	SYNC_MANAGER_INVALID_ADDRESS
134480276	SYNC_MANAGER_INVALID_IO_SIZE
134480277	SYNC_MANAGER_INVALID_CONFIGURATION
134480278	DC_ACTIVATION_REGISTER_INVALID
134480279	SYNC_TYPE_NOT_SUPPORTED
134873352	IO_LINK_EVENT
134873420	IO_LINK_INVALID_CYCLE_TIME
134873421	VERSION_ERROR_INCOMPATIBLE_PROTOCOL_VERSION
134873422	ISDU_BATCH_FAILED
134873451	WRONG_VENDORID
134873463	BACKUP_INCONSISTENCY_UPLOAD_ERROR
134873464	PARMETER_INCONSISTENCY_DOWNLOAD_ERROR
134873471	PROCESS_DATA_CONFIGURATION_ERROR
134873474	IO_LINK_EVENTS_OVERFLOW
134873475	MEMORY_OUT_OF_RANGE
134873476	DATA_STORAGE_INDEX_NOT_AVAILABLE
134873477	NON_SPECIFIC_ERROR_DURING_DATA_STORAGE
134873512	WRONG_DEVICEID
134873513	NO_DEVICE_CONNECTED

Value	Description
167772490	FUSE_BLOWN_OPENED
167837945	ERROR_RTE_MODULE_WATCHDOG_MONITORING
184549646	GENERAL_SOFTWARE_ERROR
184549696	SYSTEM_START
184811703	FIRMWARE_INVALID
185074063	UNSUPPORTED_FULL_DIAGNOSTIC_IMAGE_VERSION
185074064	UNSUPPORTED_DIAGNOSTIC_VERSION
185139496	APDD_INVALID
185139497	START_UP_APDD_INVALID
218169821	DIAGNOSIS_TRACE_RESETTED
65535	INVALID_SLAVEID_OR_COMMUNICATION_ERROR

Table 4.2.3-2 eErrorDescription

4.3 FB 功能演示

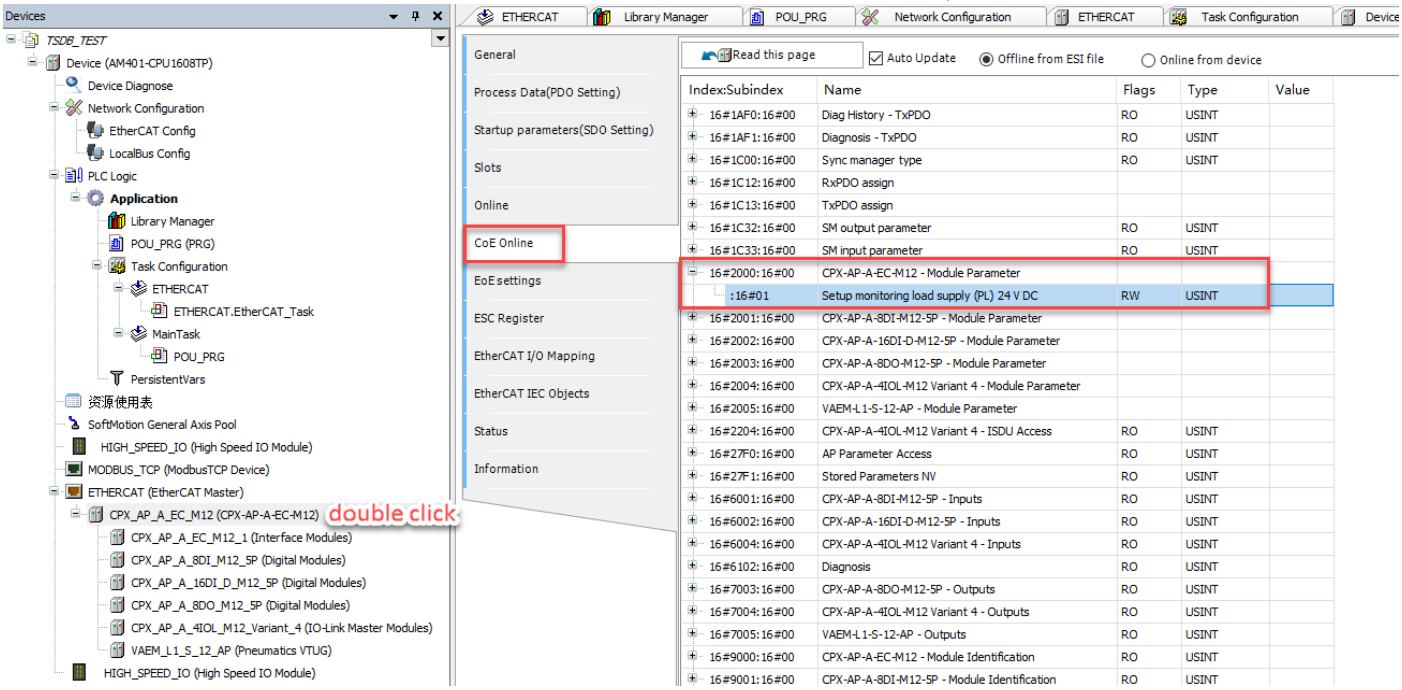
4.3.1 使用 CPXAP_Parameter_CoE 功能块读或写 CPX-AP 设备参数

读取参数示例：

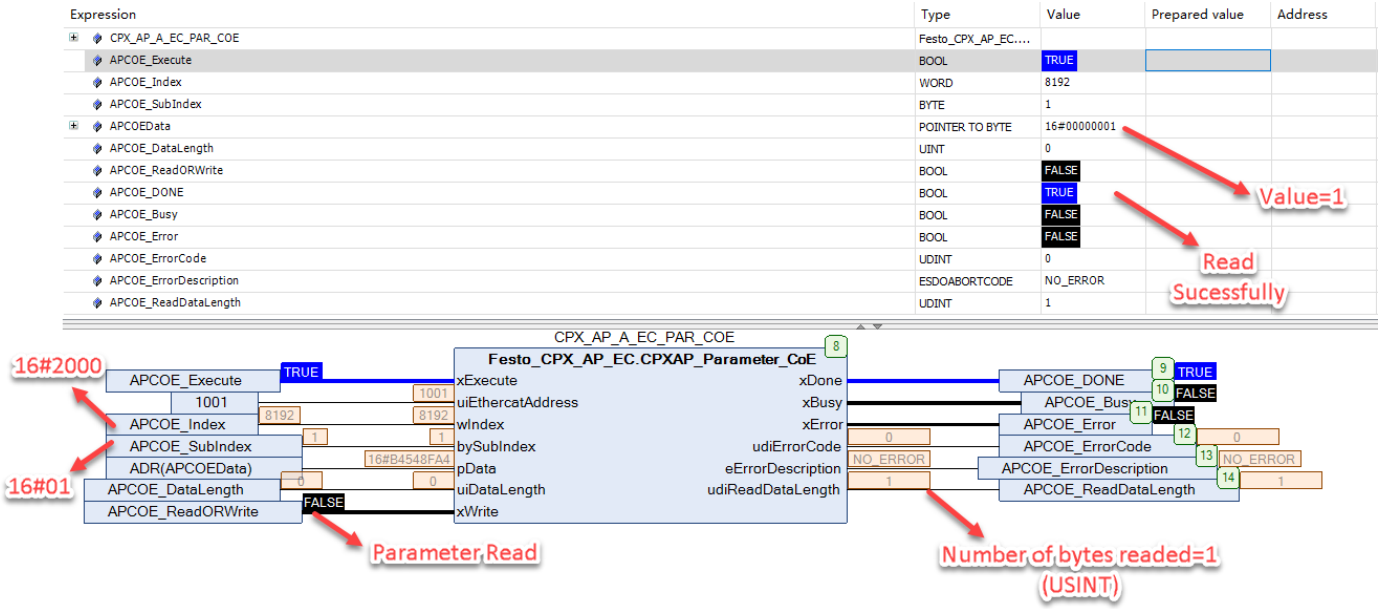
读取 CPX-AP-A-EC-M12 的参数“Setup Monitoring Load Supply PL”，出厂默认参数值为 1。

Parameter	Instances	Data type	Access[1])	Array size
Configuration of voltage monitoring load supply PL – 0: load voltage monitoring inactive – 1: load voltage monitoring active, with suppression of diagnostics at switch-off (factory setting) – 2: load voltage monitoring active	1	UINT8	rw	–

通过 COE-ONLINE 菜单可以获取到设备参数的 Index 及 SubIndex。Index=16#2000, SubIndex=16#01。



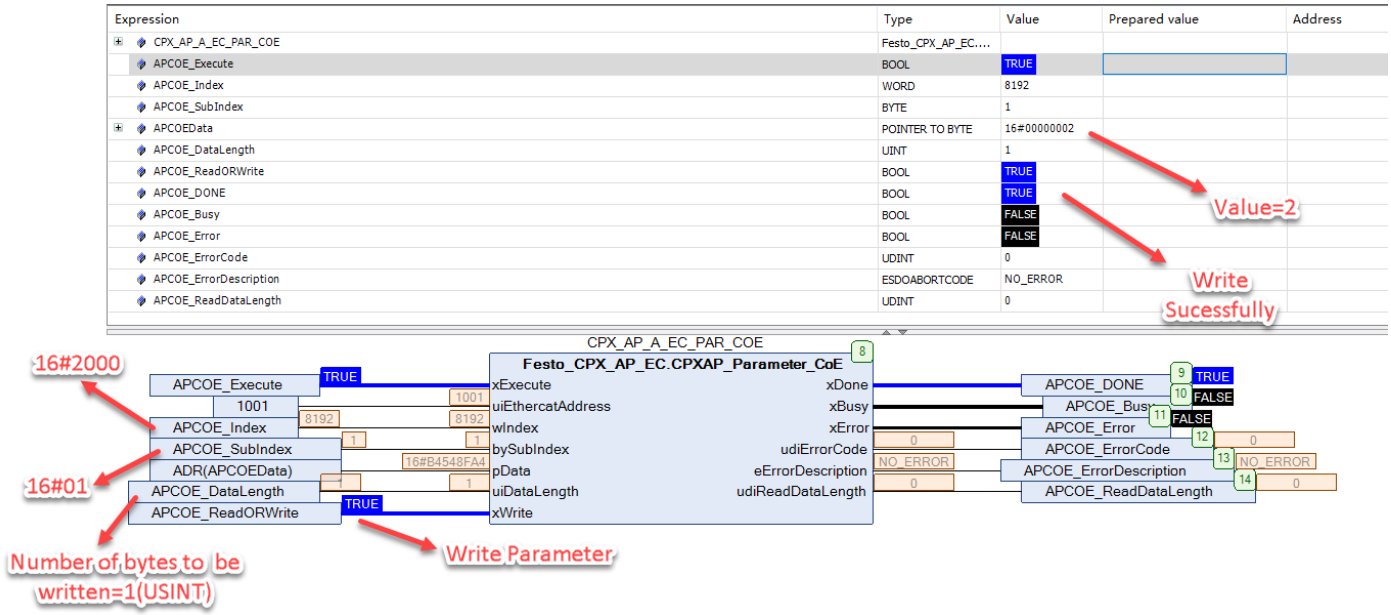
指定 APCOE_Index=16#2000，APCOE_SubIndex=16#1 及触发 Execute 后变量 APCOEData 得到相关参数值为 1。



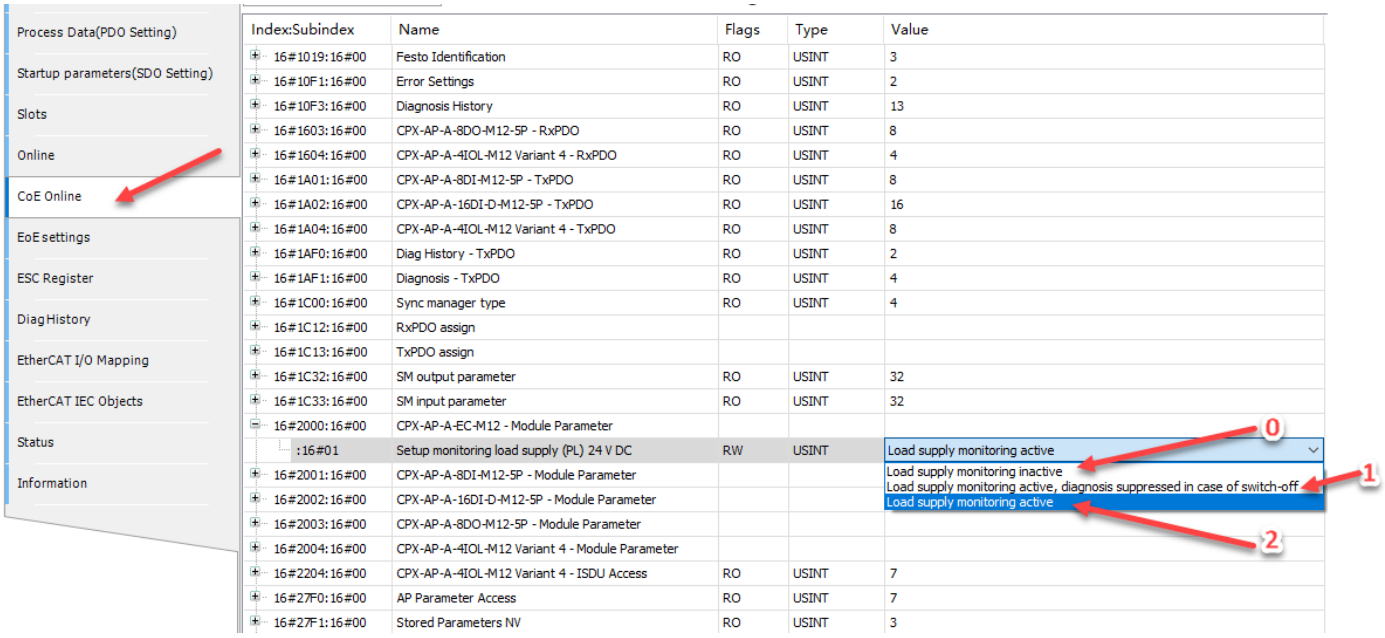
修改参数示例：

修改 CPX-AP-A-EC-M12 的参数“Setup Monitoring Load Supply PL”为 Load voltage monitoring active,参数值为 2。

指定 APCOE_Index=16#2000，APCOE_SubIndex=16#1, APCOEData=16#2 ,APCOE_DataLength=16#1, APCOE_ReadORWrite=TRUE 及触发 Execute 后 DONE 信号完成。



通过 CoE-Online 确认参数修改成功。



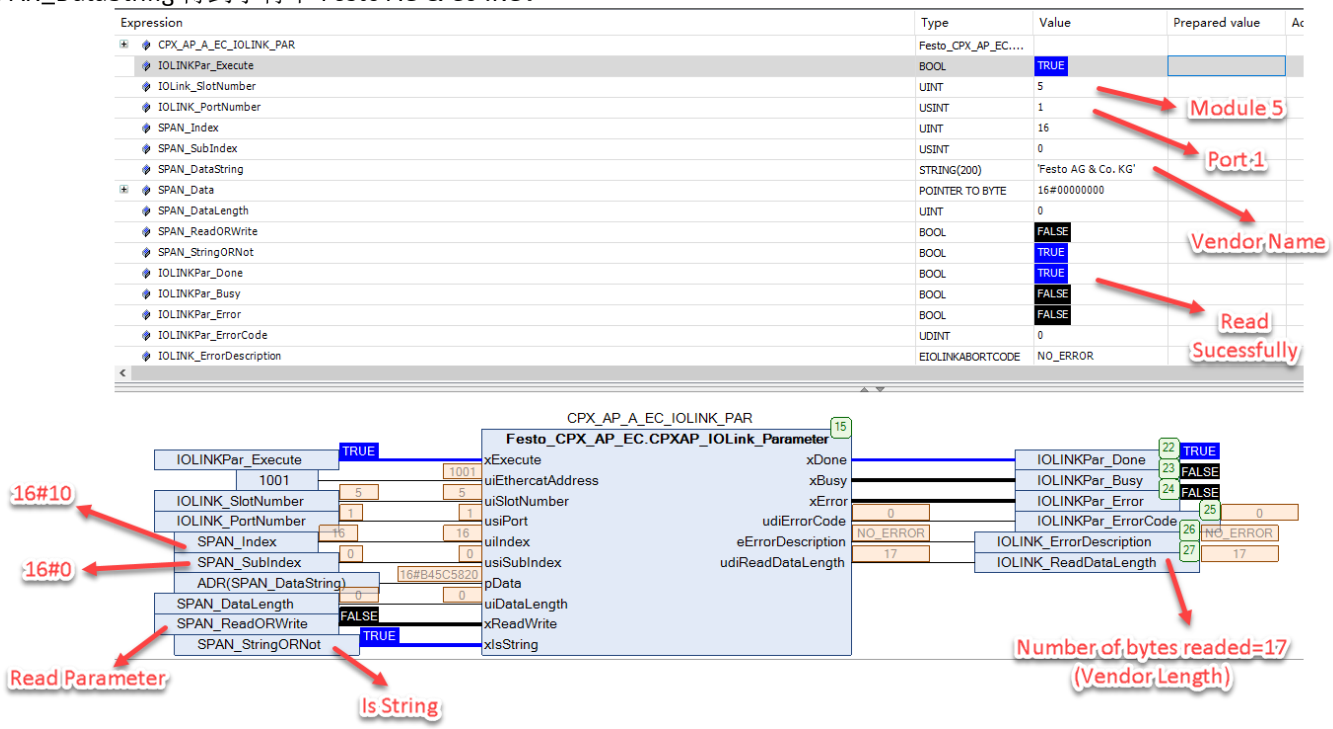
4.3.2 使用 CPXAP_IOLink_Parameter 功能块读或写 IO-LINK 设备参数

读取参数示例：

读取连接在 CPX-AP-A-4IOL 模块端口 1 的压力传感器 SPAN-LK 的生产厂家。

Index	Subin-dex	Name	Value (example)	Access[1)]			Length	Format
				U	M	S		
0x0010	0	Vendor Name	Festo AG & Co. KG	R	R	R	17 bytes	String

指定 IOLINK_SlotNumber=16#5，IOLINK-PortNumber=1,SPAN_Index=16#10,SPAN_SubIndex=16#0 及触发 Execute 后变量 SPAN_DataString 得到字符串 Festo AG & Co .KG。

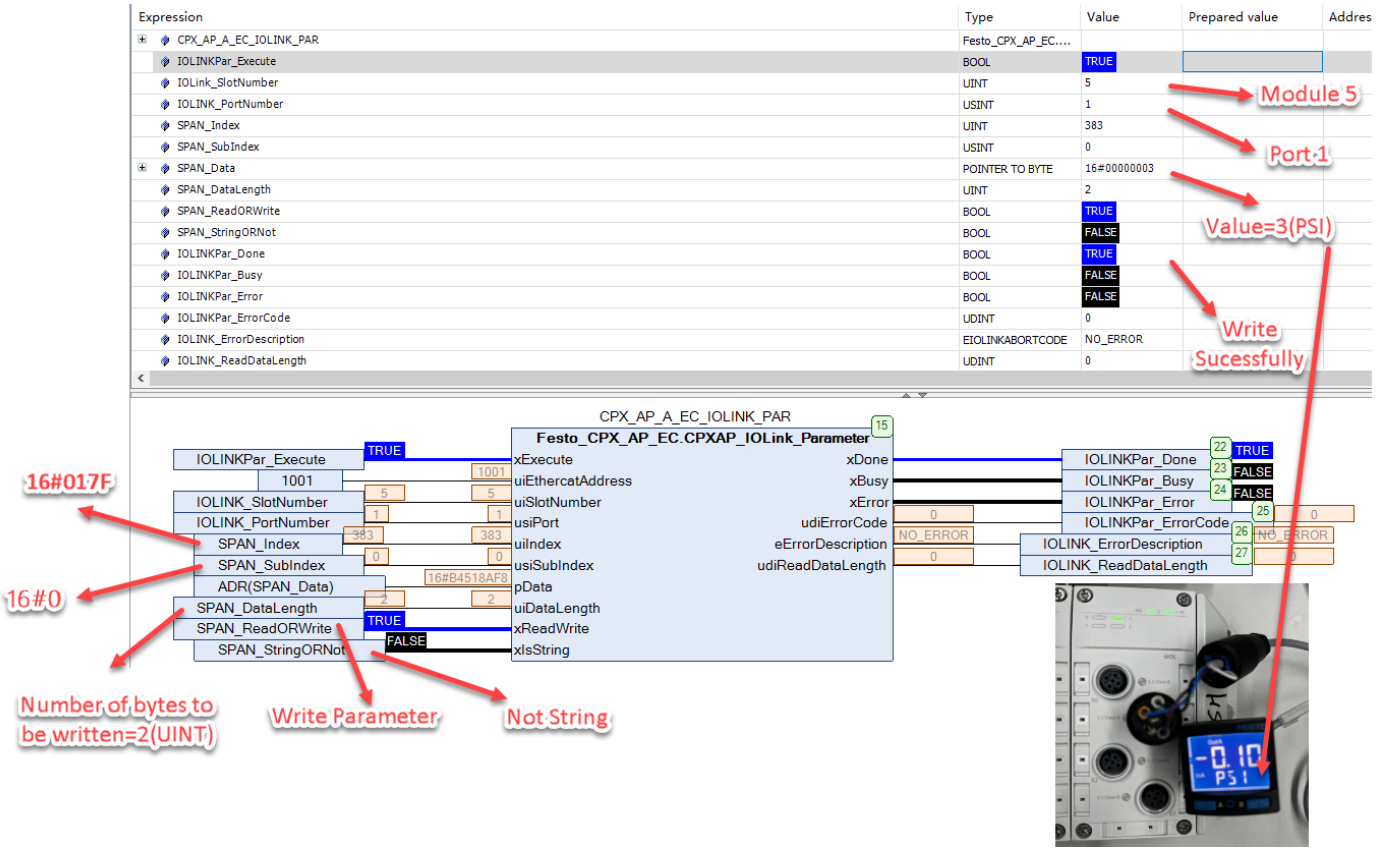


修改参数示例：

修改连接在 CPX-AP-A-4IOL 模块端口 1 的压力传感器 SPAN-LK 的压力显示单位为 PSI（Value=3）。

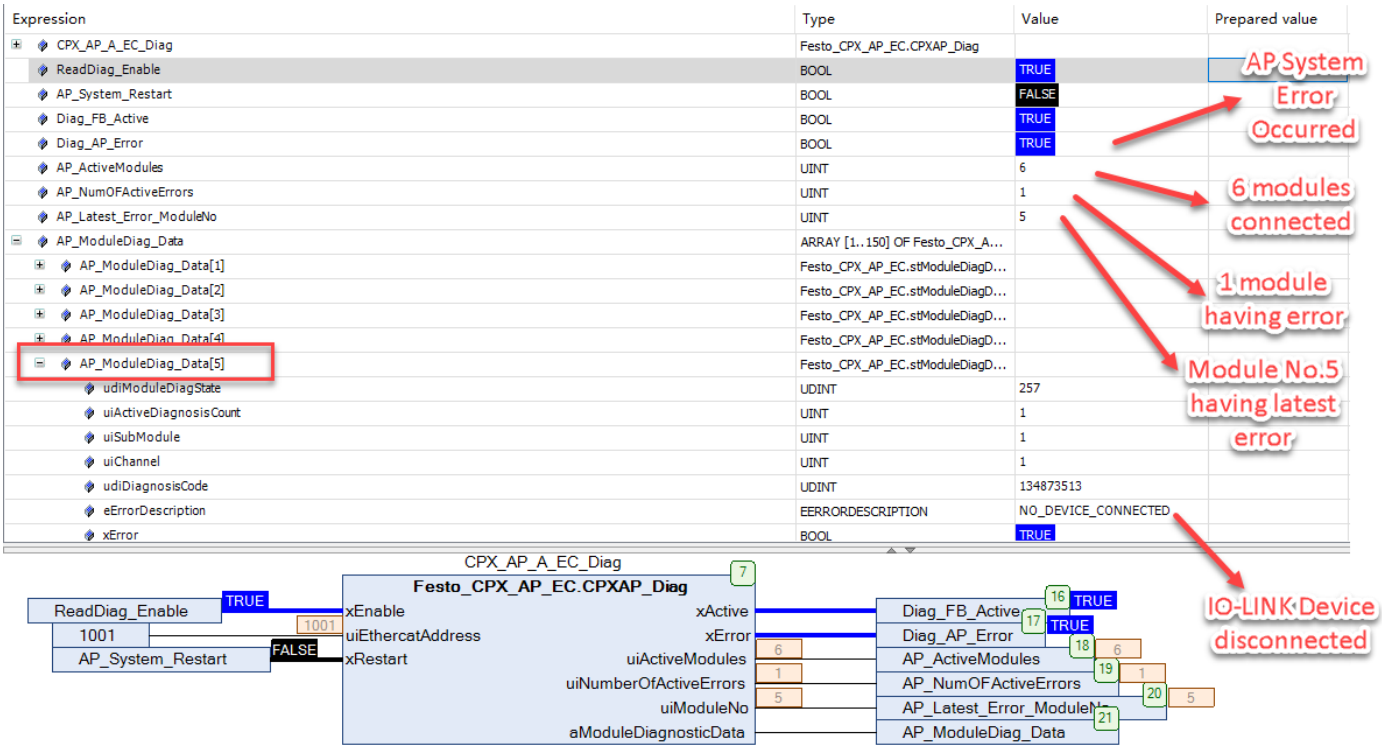
Index	Sub-Index	Name	Value	Access[1)]			Length	Format
				U	M	S		
0x017F	0	InA, unit	0 = bar (default), 1-kPa, 2-Mpa, 3-psi, 4-mmHG, 5-inHG, 6-inH2O, 7-kgf/cm²	R	R/W	R/W	2 Bytes	UInteger16

指定 IOLINK_SlotNumber=16#5，IOLINK-PortNumber=1,SPAN_Index=16#017F,SPAN_SubIndex=16#0, SPAN_Data=16#3,SPAN_DataLength=16#2,SPAN_ReadORWrite=TRUE,及触发 Execute 后 DONE 信号完成，且压力表单位已被更改为 PSI.

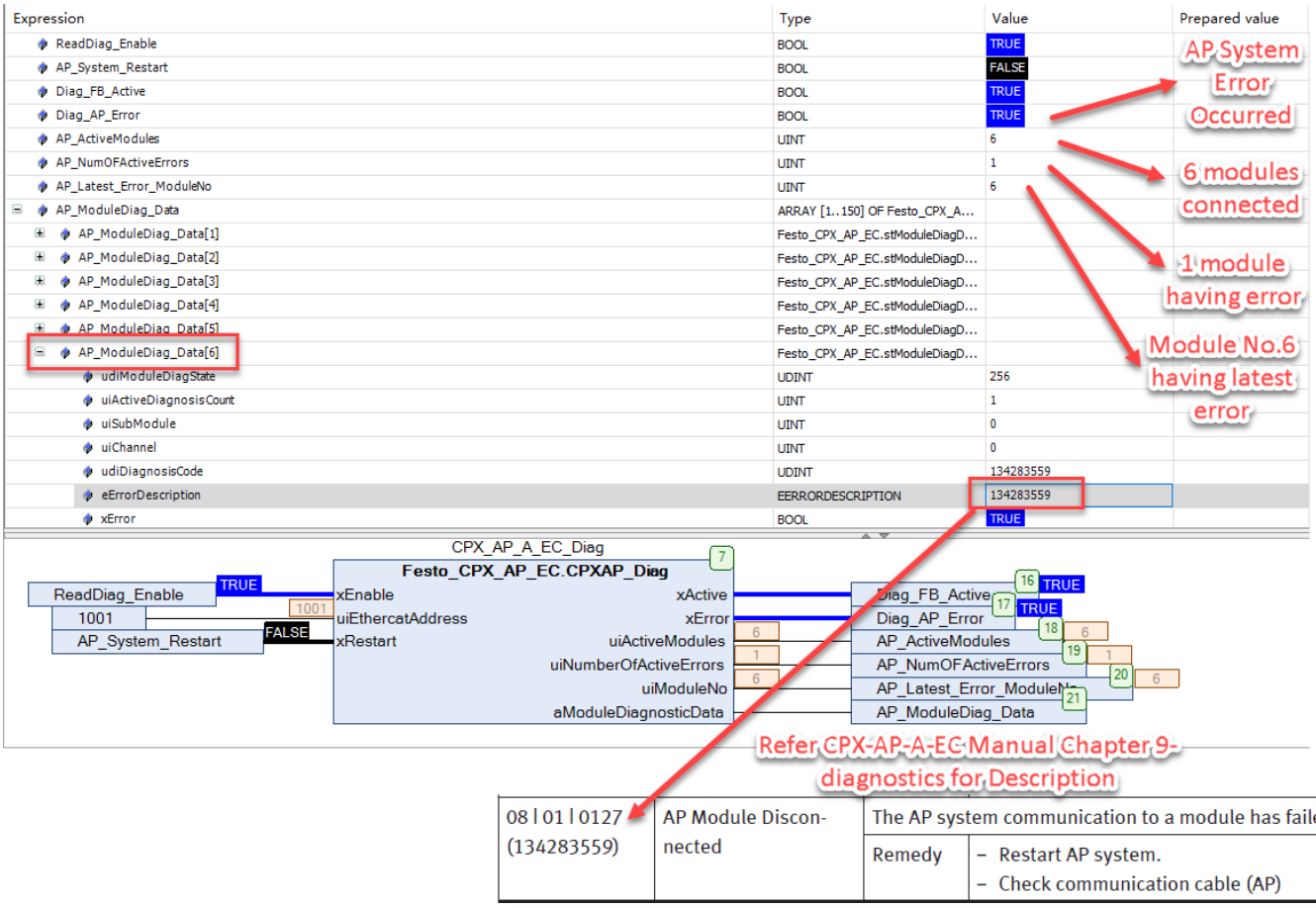


4.3.3 使用 CPXAP_Diag 功能块读取 AP 系统故障代码

示例 1：断开 IO-LINK 设备压力传感器 SPAN-LK

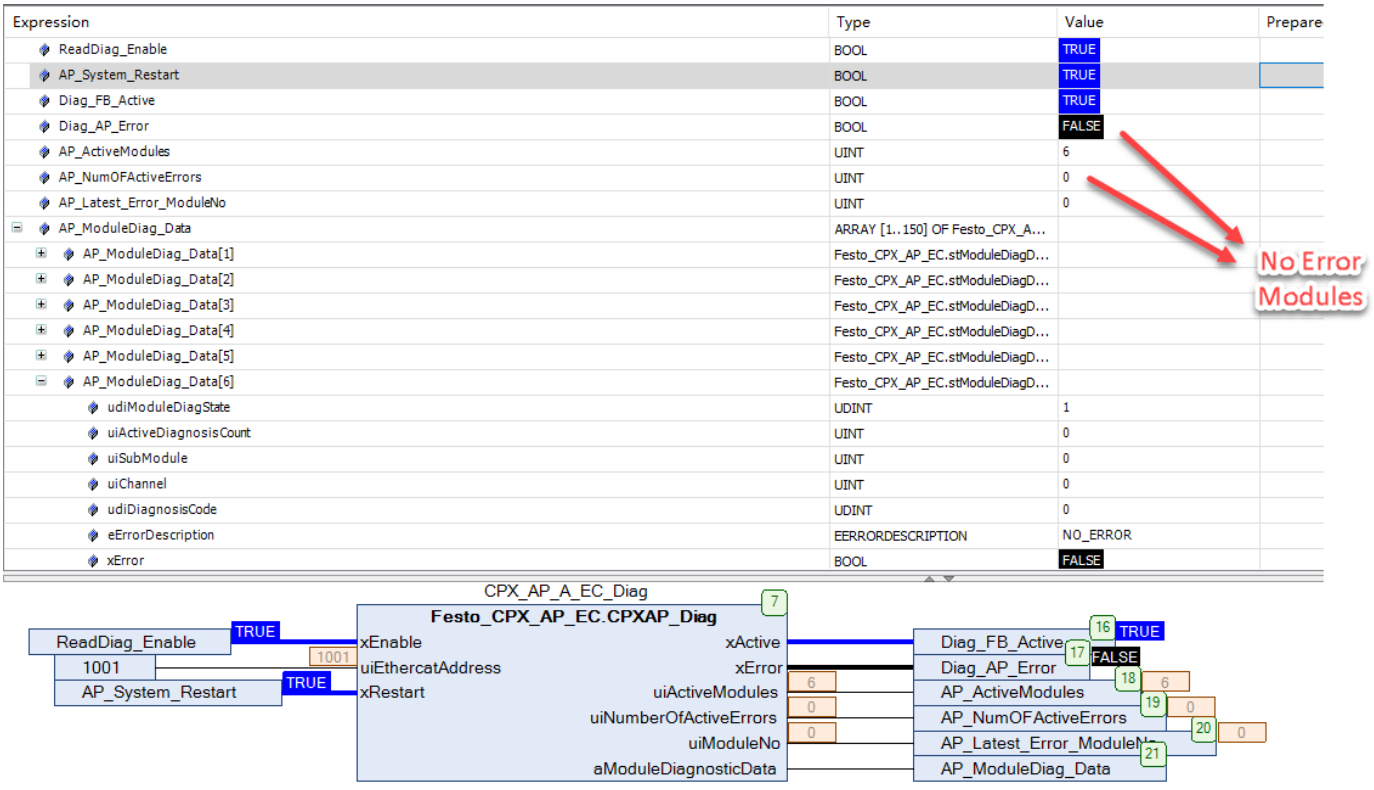


示例 2：断开模块 6-VTUG 阀岛的 AP 电缆



08 | 01 | 0127 (134283559)	AP Module Disconnected	The AP system communication to a module has failed.
	Remedy	– Restart AP system. – Check communication cable (AP)

确认并正确连接 AP 线缆后，可通过触发 xRestart 进行 AP 系统重启故障复位。



5 诊断功能

5.1 LED 诊断

Module diagnostics [MD]		
LED (red, green)	Meaning	Remedy
 off	Logic supply PS not available.	Check connection of logic supply PS.
 green light	Module diagnostics not active	–
 flashing green 0.5 Hz	Module diagnostics active Degree of severity "Information" e.g. switching off load supply PL	–
 flashing red 0.5 Hz	Module diagnostics active Degree of severity "Warning" e.g. parameterisation error	Take appropriate remedial action, e.g. check parameterisation.
 red light	Module diagnostics active Degree of severity "Error" e.g. undervoltage in logic supply PS	Take appropriate remedial action, e.g. check logic supply PS.
 flashing red 2 Hz	Module ramp-up not yet completed. System communication not yet initial-ised.	–
 flashing green 2 Hz	Module identification (service function)	–

Tab. 23: LED module diagnostics [MD]

System diagnostics [SD]		
LED (red, green)	Meaning	Remedy
off	Logic supply PS not available.	Check connection of logic supply PS.
green light	System diagnostics not active	–
flashing green 0.5 Hz	System diagnostics active Degree of severity "Information" e.g. load supply PL to a module not available or firmware update in a module active.	–
flashing red 0.5 Hz	System diagnostics active Degree of severity "Warning" e.g. parameterisation error in a module.	
red light	System diagnostics active Degree of severity "Error" e.g. sensor supply short circuit in a module.	
flashing green 2 Hz	Module identification (service function)	–

Tab. 24: LED system diagnostics [SD]

Load supply [PL]		
LED (red, green)	Meaning	Remedy
green light	Load supply PL available.	–
flashing green 0.5 Hz	Load supply PL not available.	Check load supply PL.
flashing red 0.5 Hz flashing red	Load supply PL outside the tolerance range.	Check load supply PL.

Tab. 25: LED load supply [PL]

Maintenance [MT]		
LED (yellow)	Meaning	Remedy
off	Maintenance not required.	–
on	Maintenance required in at least one module in the automation system CPX-AP.	Carry out the necessary remedial measures ➔ Instructions for the applicable module.

Tab. 26: LED maintenance [MT]

EtherCAT operating status [RUN]		
LED (green)	Meaning	Remedy
 on	Operational normal operating status	–
 flashes	Pre-operational Configuration of EtherCAT network	–
 flashes 1x briefly	Safe operational Only the input signals are updated. The outputs retain their current status.	–
 flickers	Bootstrap The interface is receiving a firmware update.	–
 off	Initialisation Normal status after switching on or after a restart	–

Tab. 27: LED EtherCAT operating status [RUN]

EtherCAT error [ERR]		
LED (red)	Meaning	Remedy
 on	serious communication error Possible causes: – Application controller not responding – Watchdog timeout by ESC	Contact Festo Service ➔ www.festo.com.
 flashes	Configuration error, no network connection Possible causes: – Line interrupted – No connection to master – Master is not active	Check network connections. Check the configuration and addressing of the interface.
 flashes 1x briefly	EtherCAT state change from Operational to Safe-Operational due to synchronisation error	–
 flashes 2x briefly	Application watchdog timeout Watchdog timeout by the Sync Manager	–
 flickers	Booting error Error (checksum) in application controller flash memory	–
 off	no error	–

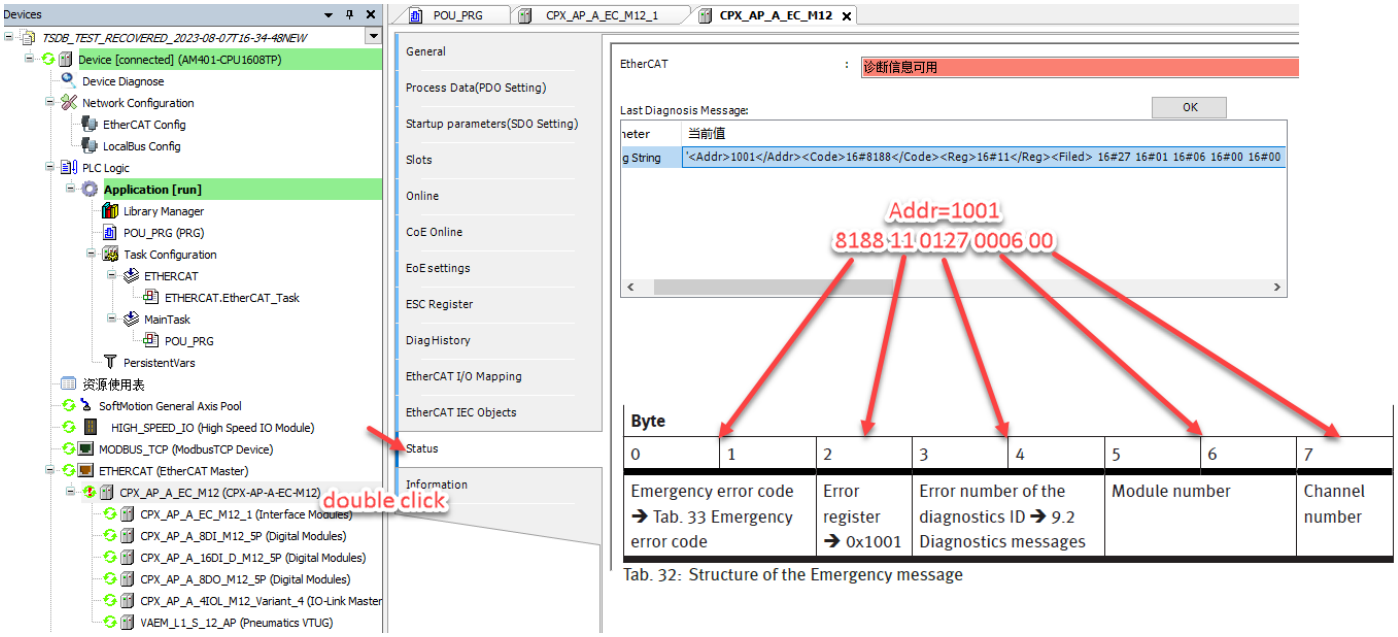
Tab. 28: EtherCAT error [ERR] LED

Connection status [LA X1], [LA X2]		
LED (green)	Meaning	Remedy
○ off	No network connection.	Check network connection.
☀ flickers	Network connection OK. Data traffic activity.	–
☀ on	Network connection OK. No data traffic.	–

Tab. 29: LED connection status [LA X1], [LA X2]

5.2 Emergency message 诊断

示例：断开模块 6-VTUG 阀岛的 AP 电缆。



Byte							
0	1	2	3	4	5	6	7
Emergency error code ➔ Tab. 33 Emergency error code		Error register ➔ 0x1001	Error number of the diagnostics ID ➔ 9.2 Diagnostics messages		Module number		Channel number

Tab. 32: Structure of the Emergency message

Emergency error code	Category	
0x2081	1	Current
0x3082	2	Voltage
0x4083	3	Temperature
0xF084	4	Pressure
0xF085	5	Motion
0x6386	6	Configuration/parameterisation
0x8087	7	Monitoring
0x8188	8	Communication
0xF089	9	Safety engineering
0x508A	10	Internal hardware
0x608B	11	Software
0xF08C	12	Maintenance
0xFF8D	13	Various
0xFF8E	14	Device-specific
0xFF8F	15	Customer-specific
0x9090	16	External device
0xF091	17	Security (data)
0x7092	18	Encoder

Tab. 33: Emergency error code

08 | 01 (134283559)	0127	AP Module Disconnected	The AP system communication to a module has failed.
			Remedy: – Restart AP system. – Check communication cable (AP)

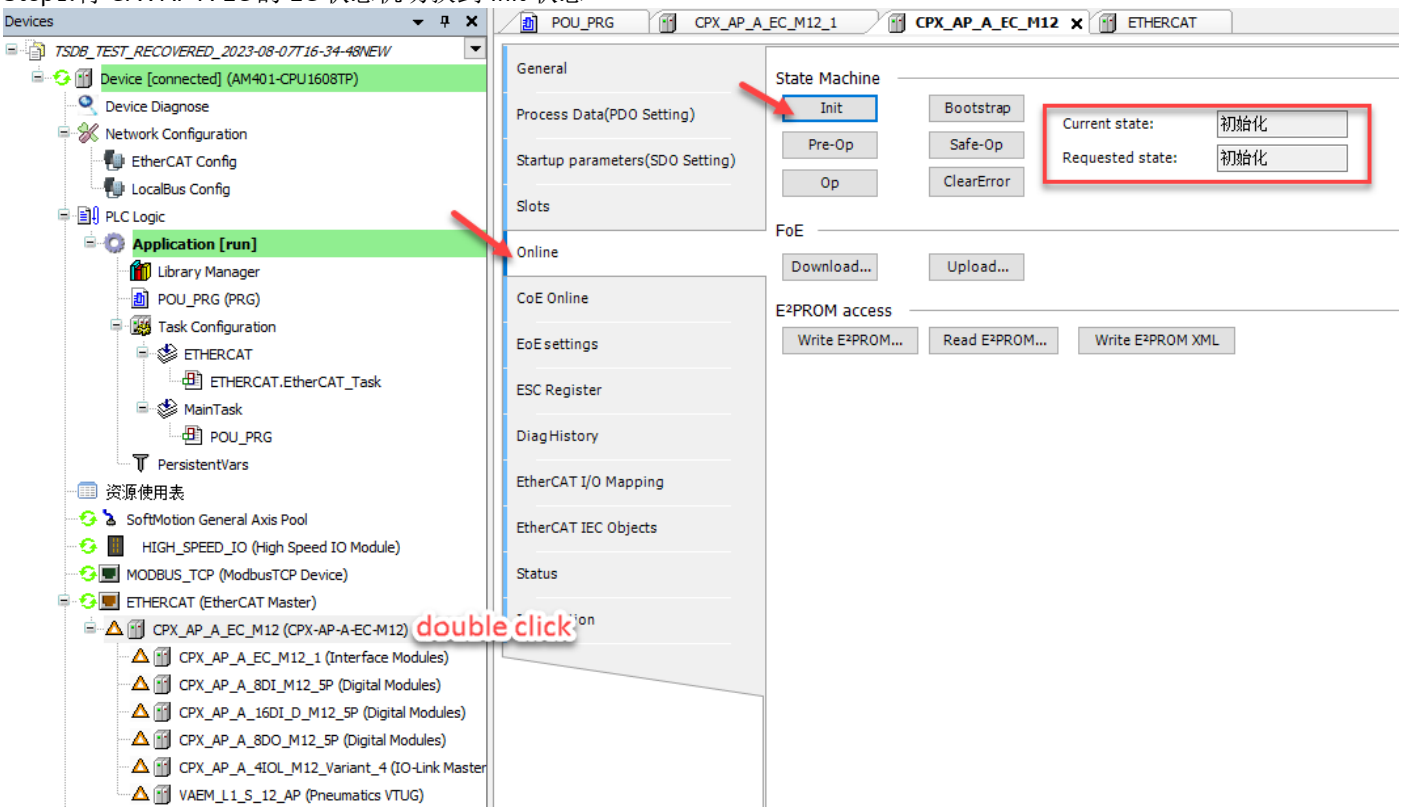
5.3 CPXAP_Diag 功能块诊断

参考 4.3.3 章节使用 CPXAP_Diag 功能块读取 AP 系统故障代码

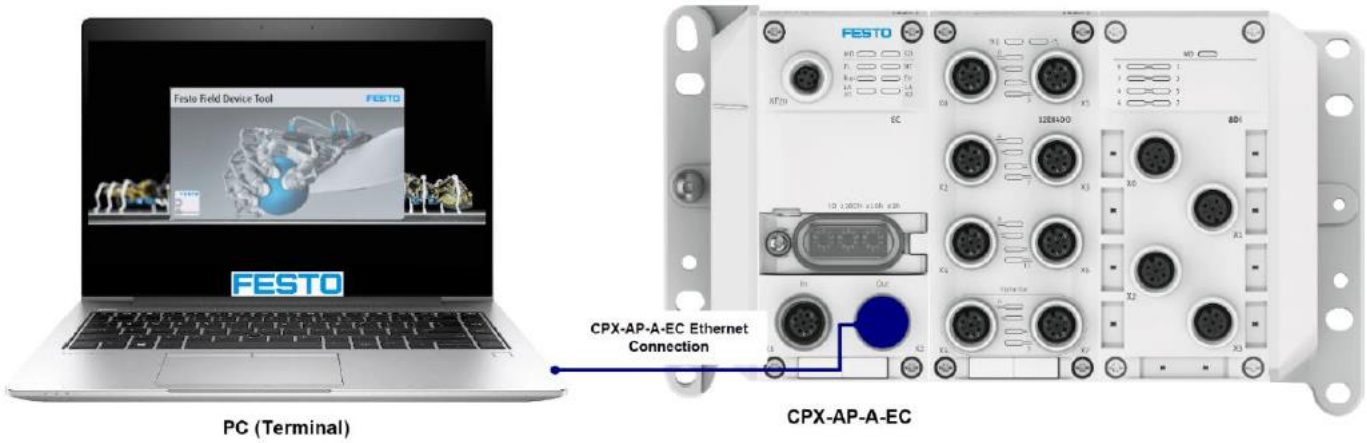
5.4 Festo Automation Suite/Web 诊断

示例：断开连接在 Port1 口上的 IO-LINK 设备压力传感器 SPAN-LK--设备丢失故障

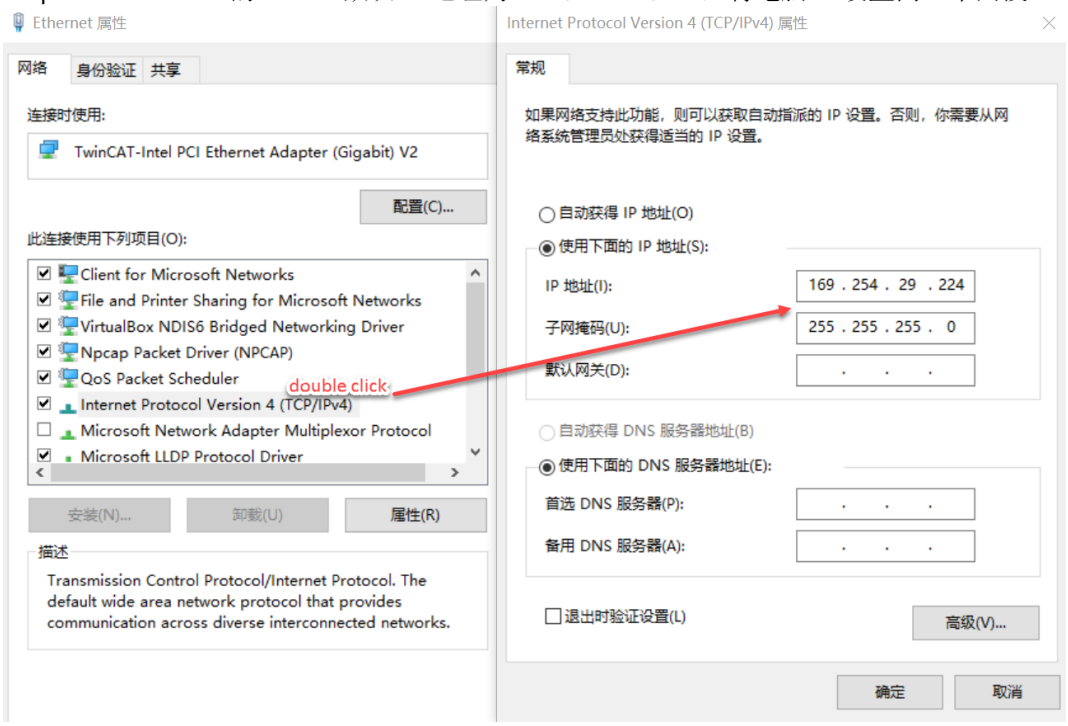
Step1.将 CPX-AP-A-EC 的 EC 状态机切换到 Init 状态



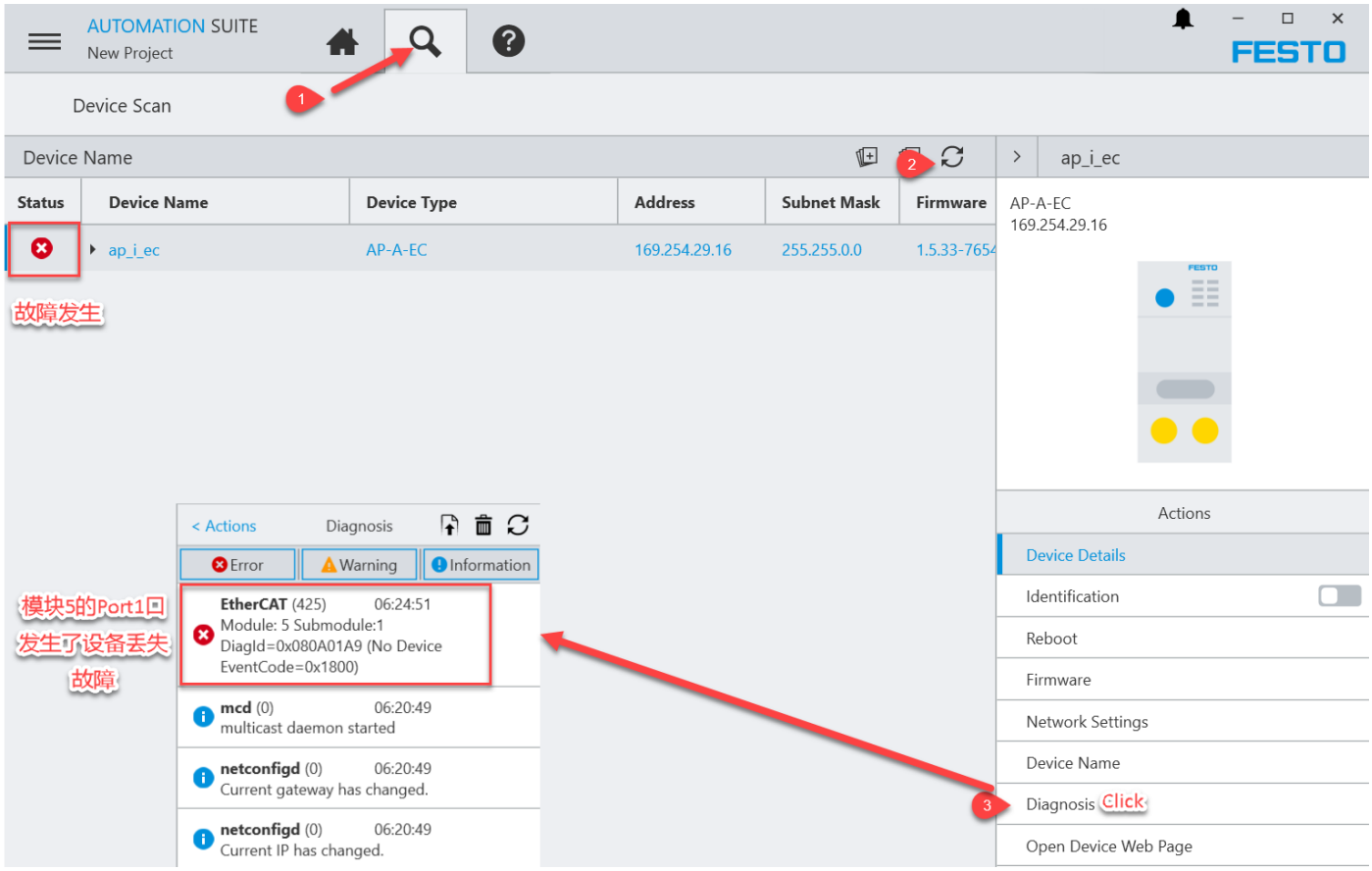
Step2.断开 EC-IN 的网线，并连接 EC-OUT 到 PC



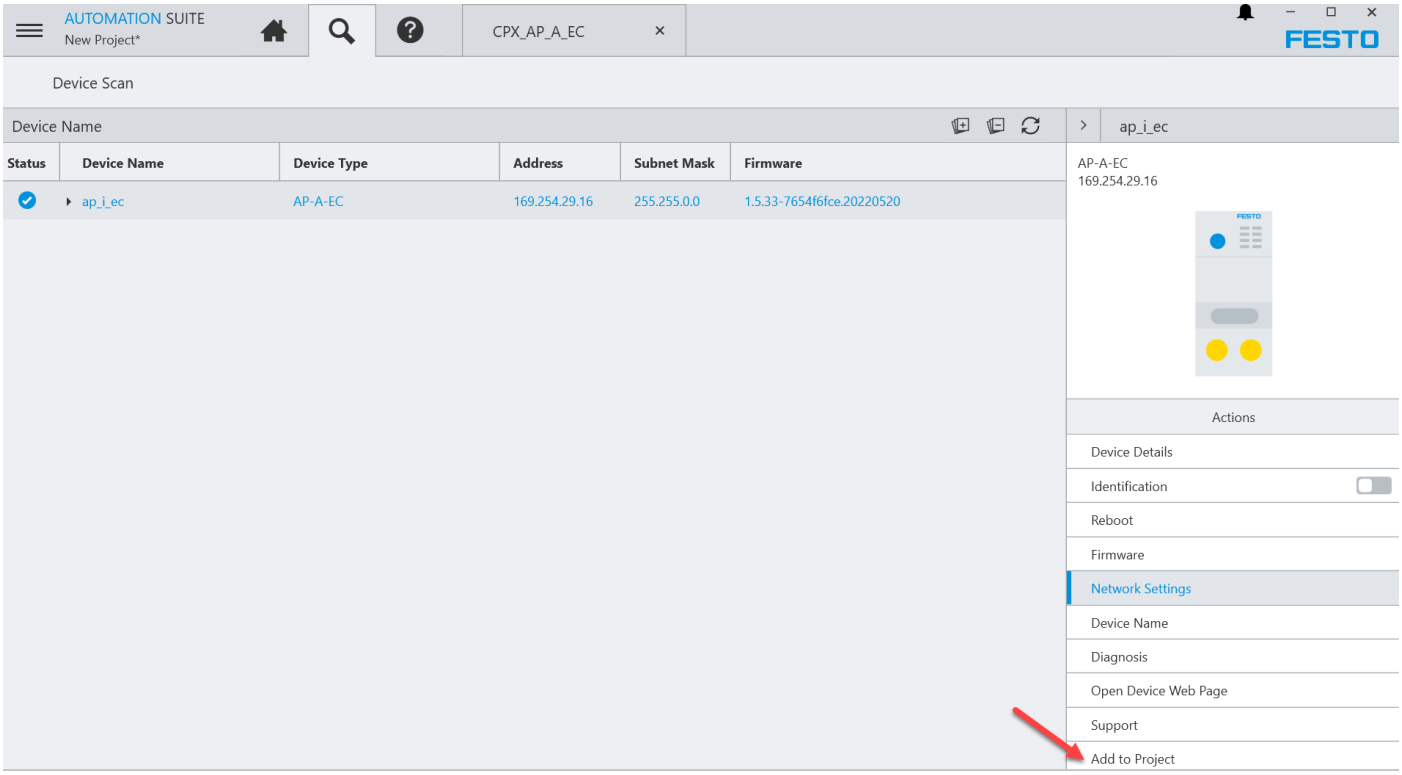
Step3: CPX-AP-A-EC 的 OUT 口默认 IP 地址为：169.254.29.16，将电脑 IP 设置同一个网段。

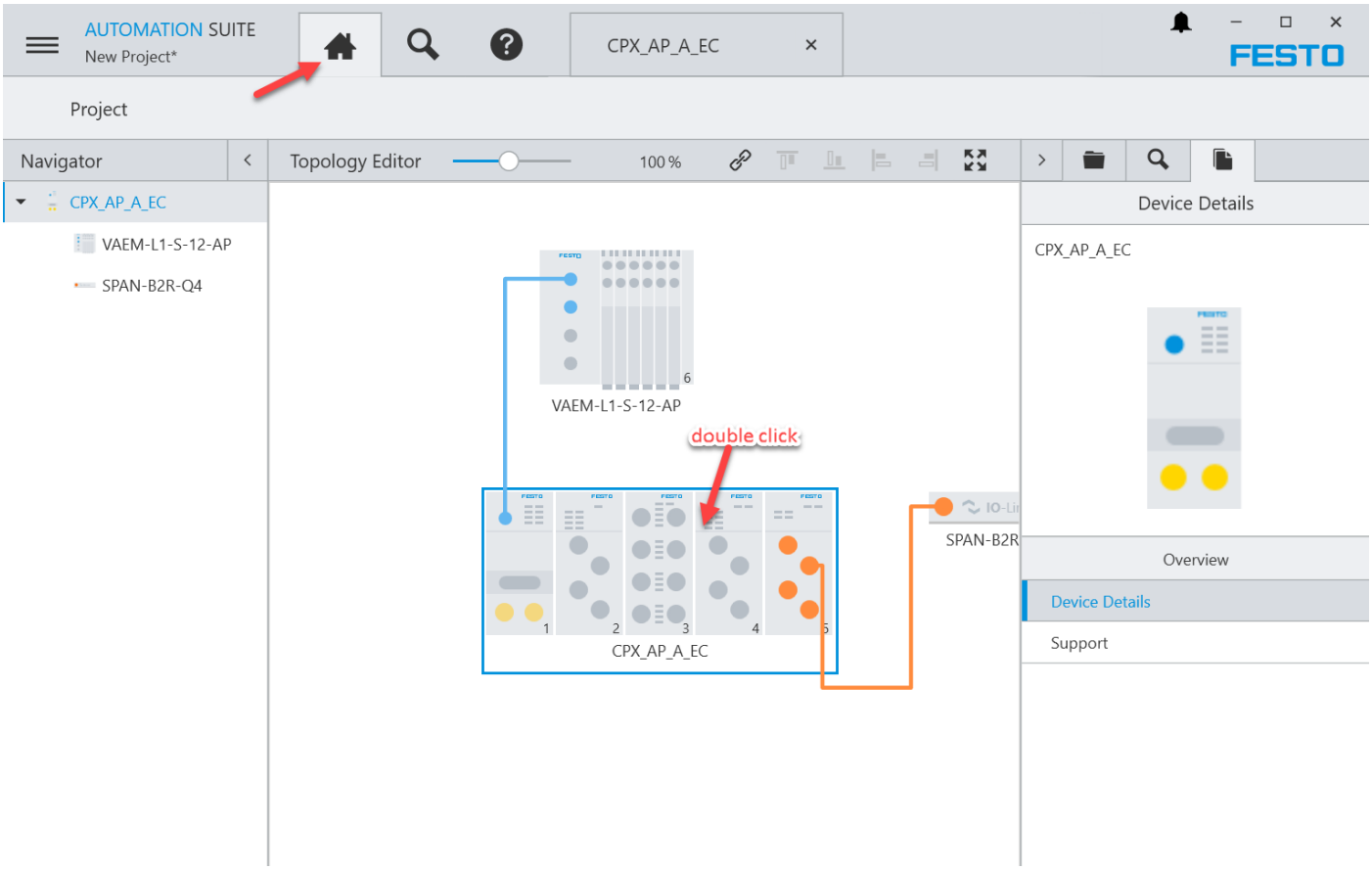


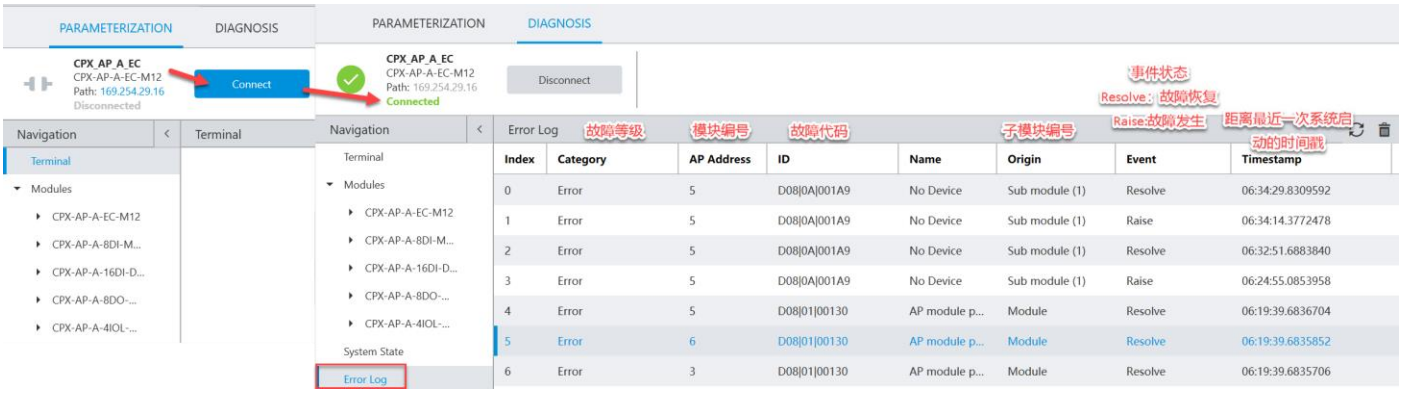
5.4.1 FAS 诊断



详细故障诊断内容可通过连接设备查看

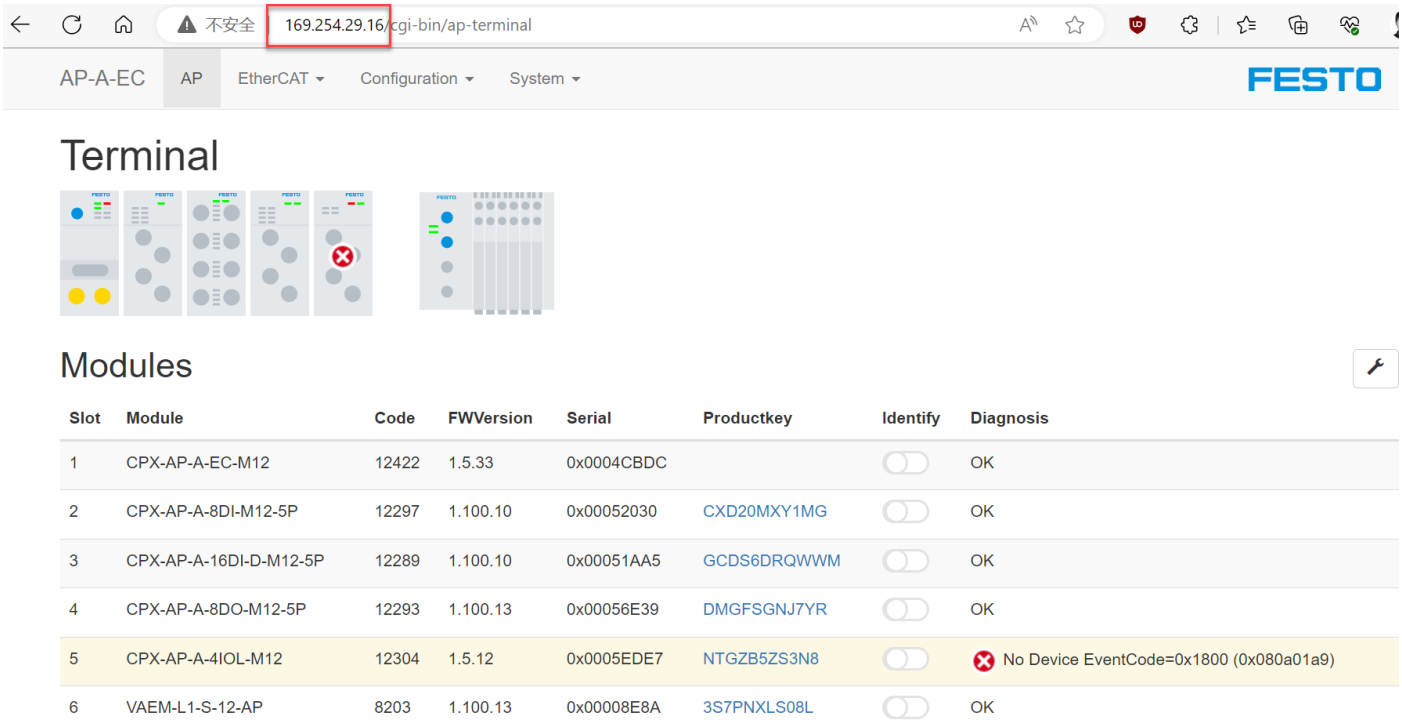




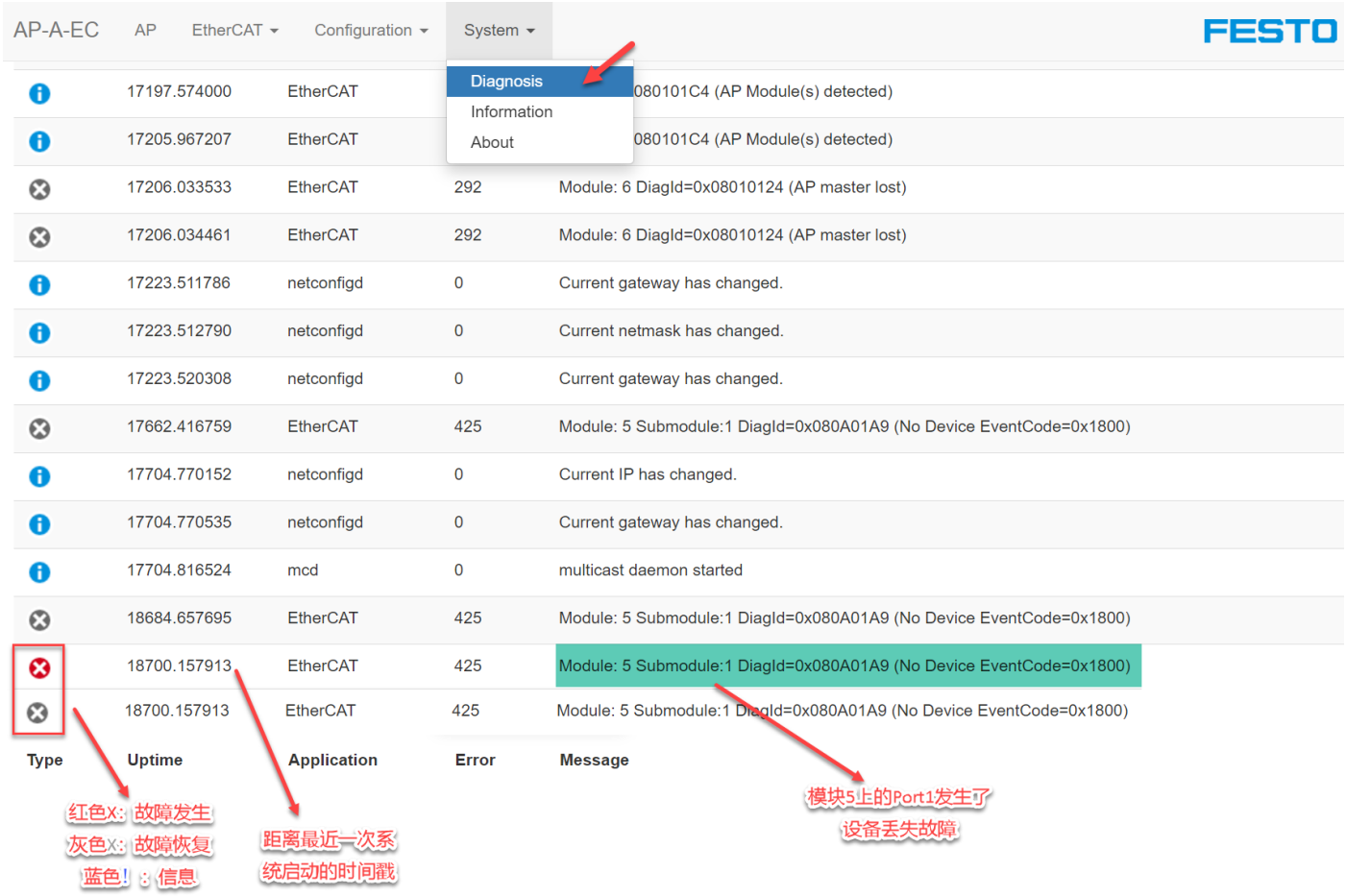


5.4.2 Web 诊断

浏览器输入 169.254.29.16 可得到如下页面：



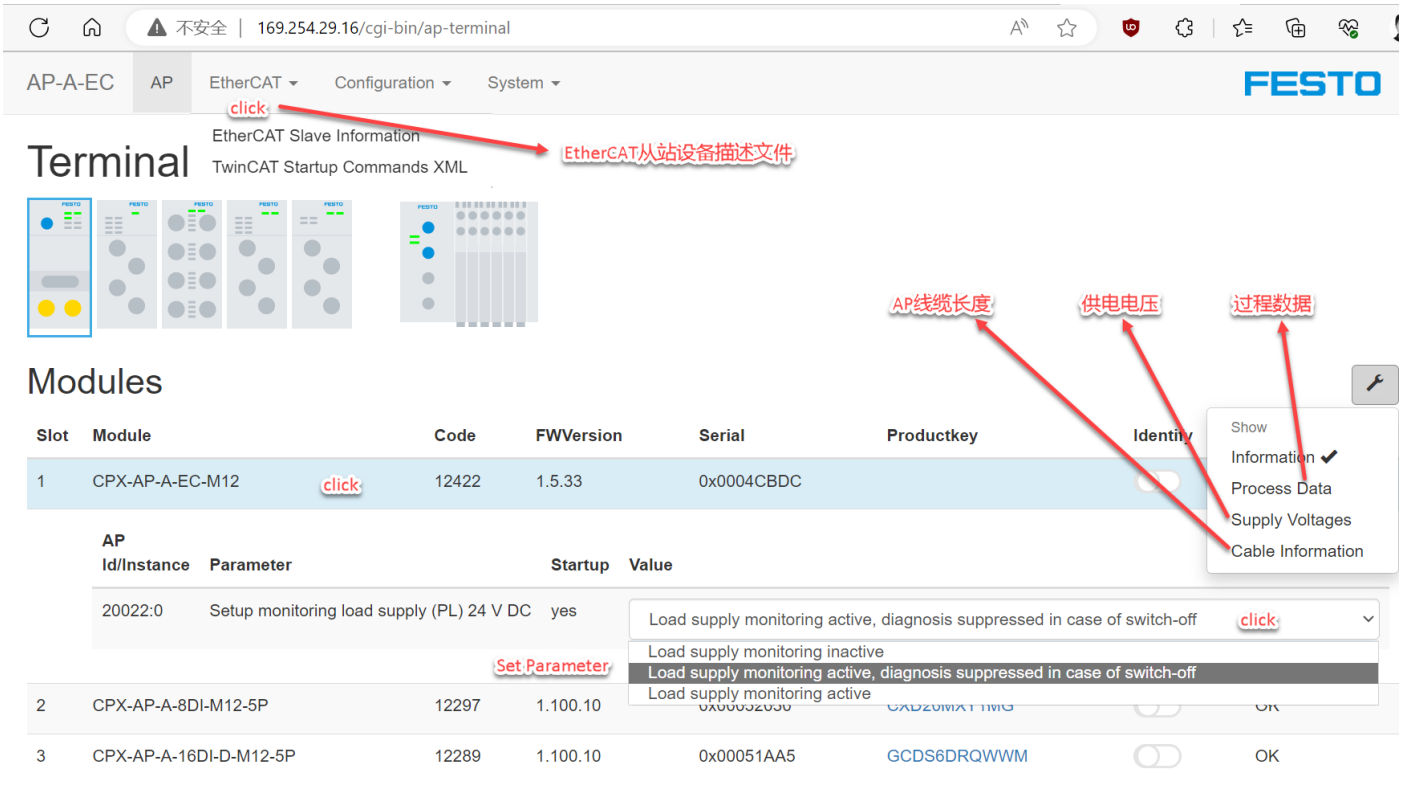
诊断界面可通过菜单栏进入



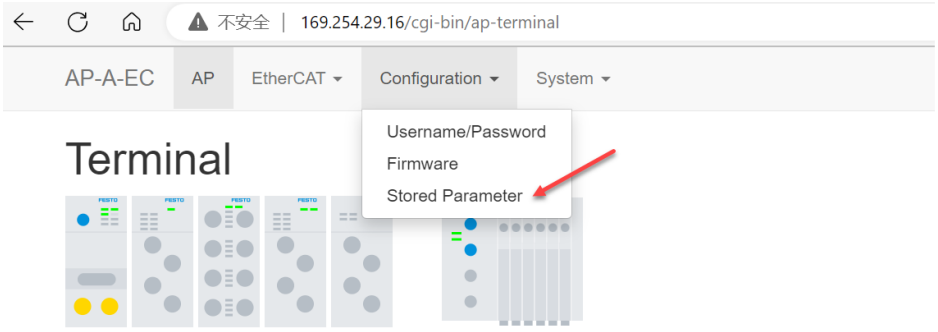
6 其他功能

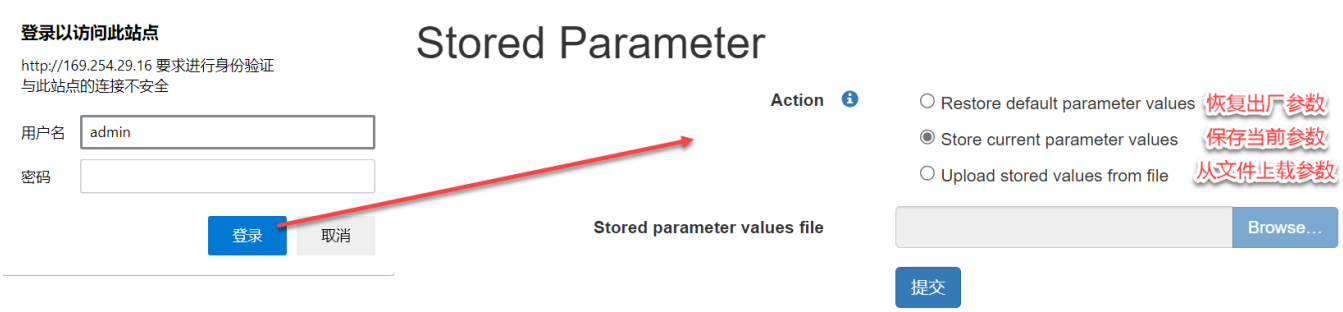
6.1 WebServer 功能简介

1.导出 ESI 文件，修改模块参数，查看各类信息



2.模块参数操作

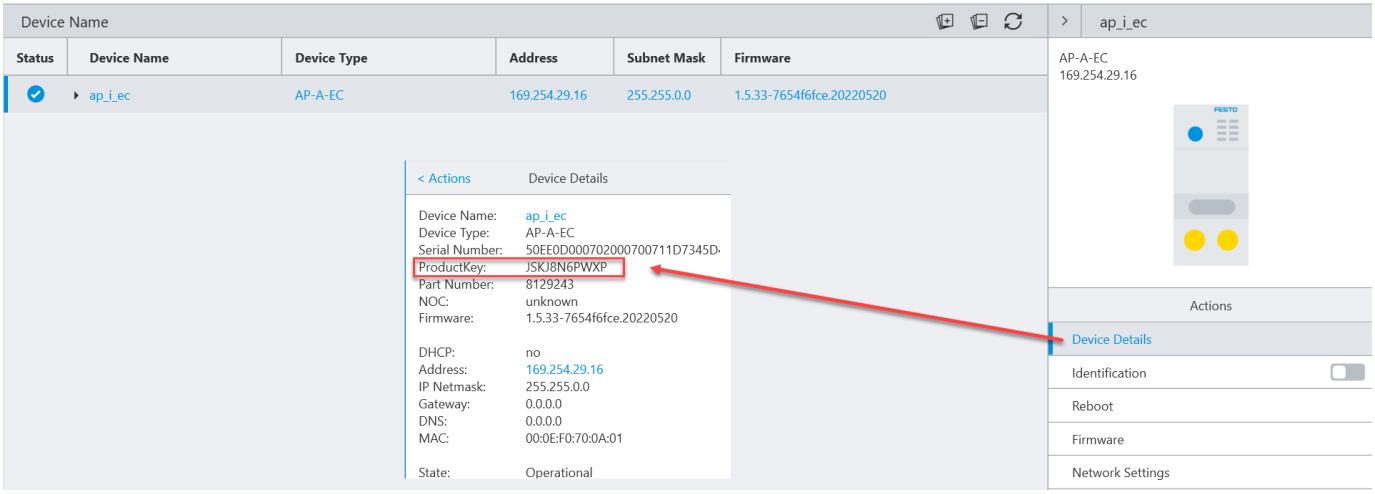




用户名：admin
密码：产品序列号（可通过两种方法查询）

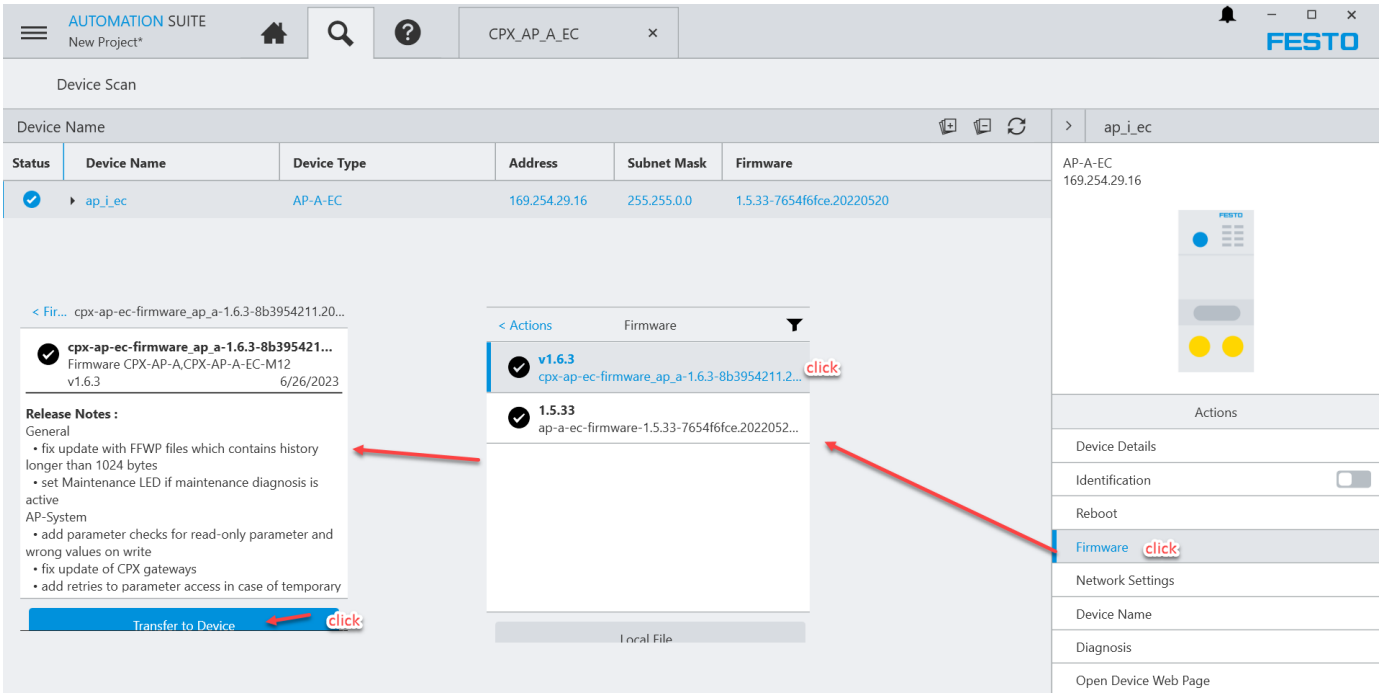
方法 1：产品硬件查询

方法 2：FAS 软件查询

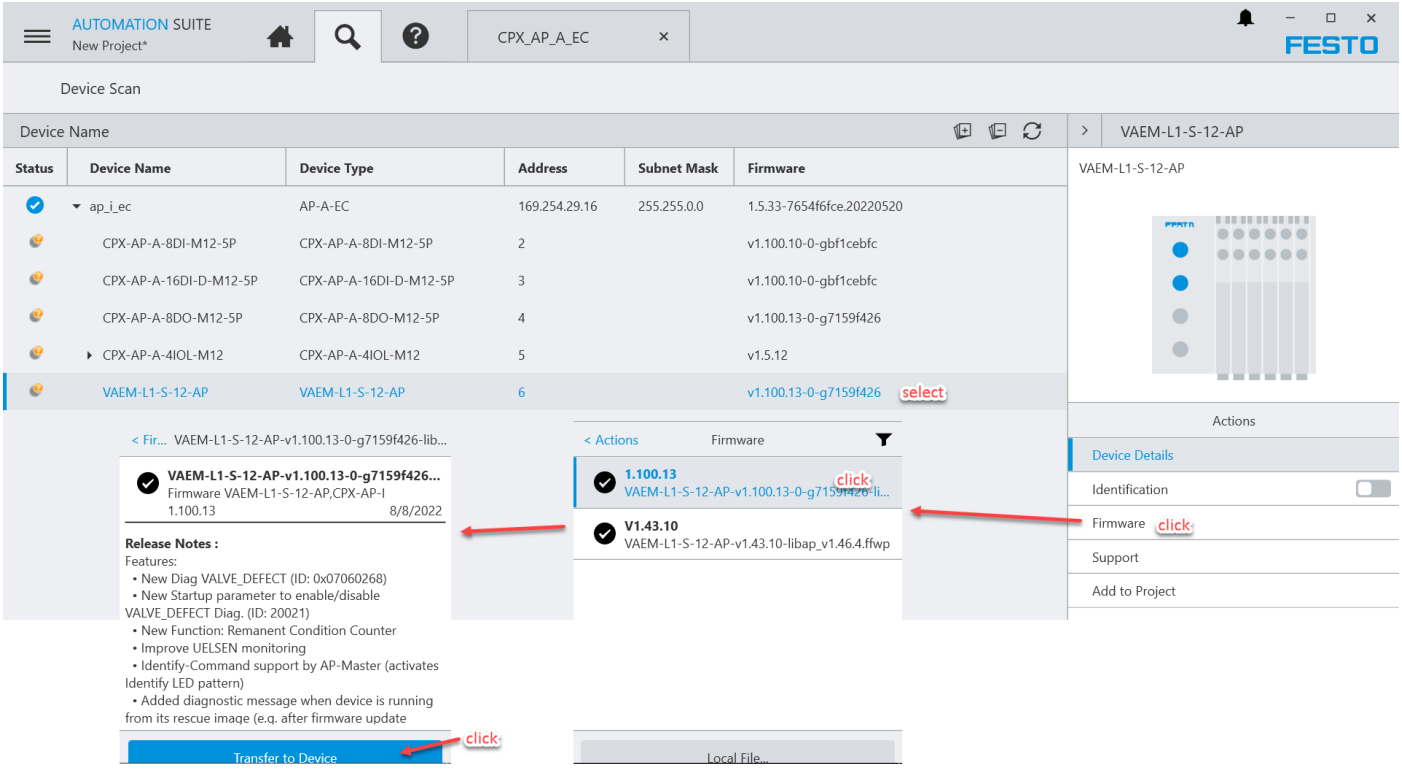


6.2 通过 Festo Automation Suite 进行固件更新

1.AP 主站固件升级



2.AP 从站固件升级



7 帮助

7.1 附录 1

CPX-AP-A-EC 手册：
https://www.festo.com.cn/cn/zh/support-portal-specific/?query=cpx-ap-a-ec&groupId=3&productName=cpx-ap-a-ec&documentId=655213

CPX-AP-A-4IOL 手册：
https://www.festo.com.cn/cn/zh/support-portal-specific/?query=8129114&groupId=3&productName=IO-Link+%E4%B8%BB%E7%AB%99&documentId=656671

VAEM-L1-S-**-AP 手册
https://www.festo.com.cn/cn/zh/support-portal-specific/?query=8081923&groupId=3&productName=%E7%94%B5%E6%8E%A5%E5%8F%A3&documentId=658933