

Ethercat主站模块X20IF10G1-1测试及汇川伺服 Ethercat通讯报告

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Summary

下表状态部分请双击修改状态颜色和显示字，人员部分请输入英文@以提到贝加莱同事，时间部分请输入英文字符//以插入日期

状态	进行中
负责人	胡斯尧
技术支持	鲁晖、麦德
问题提出时间/服务起始时间	📅 15 May 2023
问题解决时间/服务结束时间	📅 19 May 2023
优先级	HIGH
客户部门	
客户联系人	

Background

EtherCAT（Ethernet for Control and Auto-mationTechnology）是用于工业自动化的以太网解决方案，其特点是性能优越、操作简便；采用标准的以太网数据帧和符合以太网标准 IEEE 802.3 的物理层。

总部在4.25通过WeTalk发布了EtherCAT主站模块（X20IF10G1-1）的更新信息，内容概括如下：

1. 支持X20IF10G1-1的CPU型号 (X20CPx6..., X20CPx5..., Compact-S, Embedded)
2. 支持的软件版本AR E4.93
3. AS中配置方法
4. 配套软件库基本功能
5. 同步模式、性能以及功能限制
6. 产品路线图

应市场需求率先在技术部展开该Ethercat主站模块X20IF10G1-1的测试，并与汇川伺服进行ethercat通讯控制测试。

Description

根据总部资料，该模块支持硬件如下

- X20CPU系列（X20CPx6..., X20CPx5..., Compact-S, Embedded）
- 可扩展的Powerlink总线控制器 X20BC1083(无同步模式)

所需软件环境：

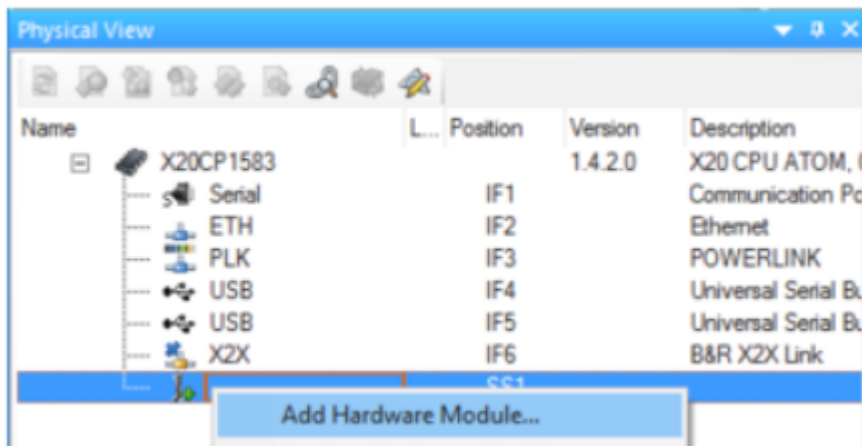
- Automation Studio V4.12及以上
- Automation Runtime E4.93

测试环境：Automation Studio 4.12， Automation Runtime E4.93

AR版本低于E4.93无法配置同步模式！！！！

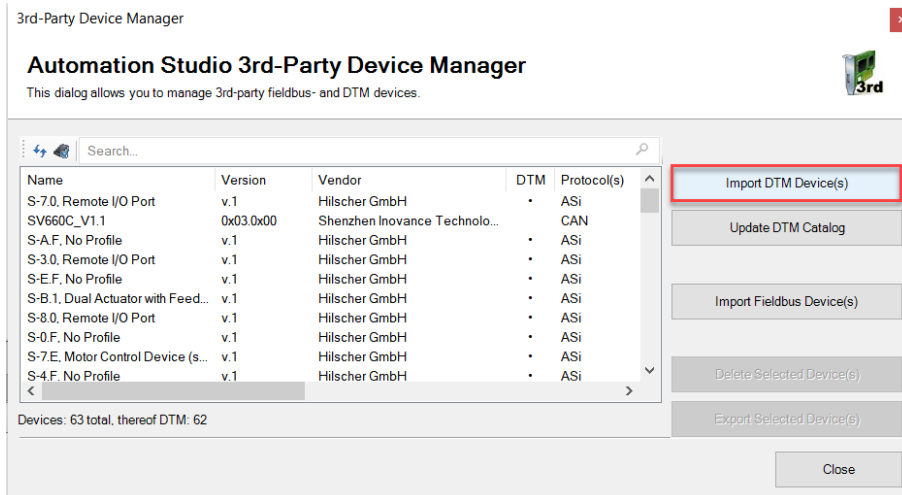
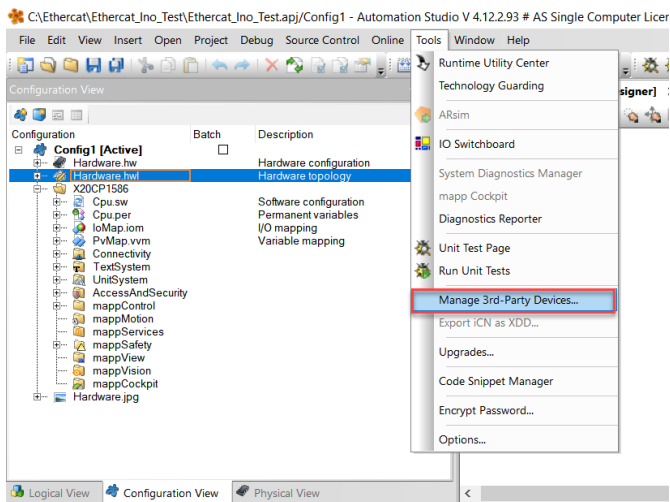
配置第三方设备Ethercat通讯步骤如下：

1. 创建新项目，添加主站通讯模块X20IFG1-1



2. 添加第三方设备

- 通过FDT/DTM
- Ethercat从站描述文件...ESI文件



3. 配置Ethercat主从站参数

- 主站周期等

IO Device:

NETX 100 RE/ECM

Vendor:

Hilscher GmbH

Device ID:

0x0000

Vendor ID:

0x0044

Navigation Area

Settings

Licensing

Configuration

General

Process Data Handshake

Topology

Tree View

Connection View

MailBox

CoE

FMMU / SyncMan

Process Data

Address Table

Init Commands

General Settings

Description:

X20IF10G1_1

Device name:

NETX 100 RE/ECM

Synchronization

Mode:

Freerun Only

Reference clock:

InoSV630N V0.1 (AutoInc.: 0x0000, Station Address: 0x0100)

Redundancy

☐

Activate redundancy

Timing settings

Bus cycle time:

1000

μs

Communication parameters

Target state:

Operational

Start of bus communication

☒

Automatically by device

OK

Cancel

Apply

- 从站设备操作模式、过程数据等

IO Device:

SV630_1Axis_03713

Vendor:

Inovance

Device ID:

0x000C0112

Vendor ID:

0x00100000

Navigation Area

Configuration

General

Behavior

Distributed Clock

Process Data

MailBox

CoE

Description

XML DDF Viewer

Distributed Clock

Operation mode:

DC-Synchron

☒

Activate DC Sync

Sync unit cycle:

1000

μs

Sync 0

☒

Activate Sync 0

Cycle Time

☒

Sync unit cycle

x 1

=

1000

μs

☐

User defined

1000

μs

Shift Time

User defined:

0

μs

+ Sync 0 cycle time

x 0

0

μs

=

0

μs

Sync 1

☐

Activate Sync 1

Cycle Time

Sync 0 cycle time x

1

Shift Time

User defined:

0

μs

OK

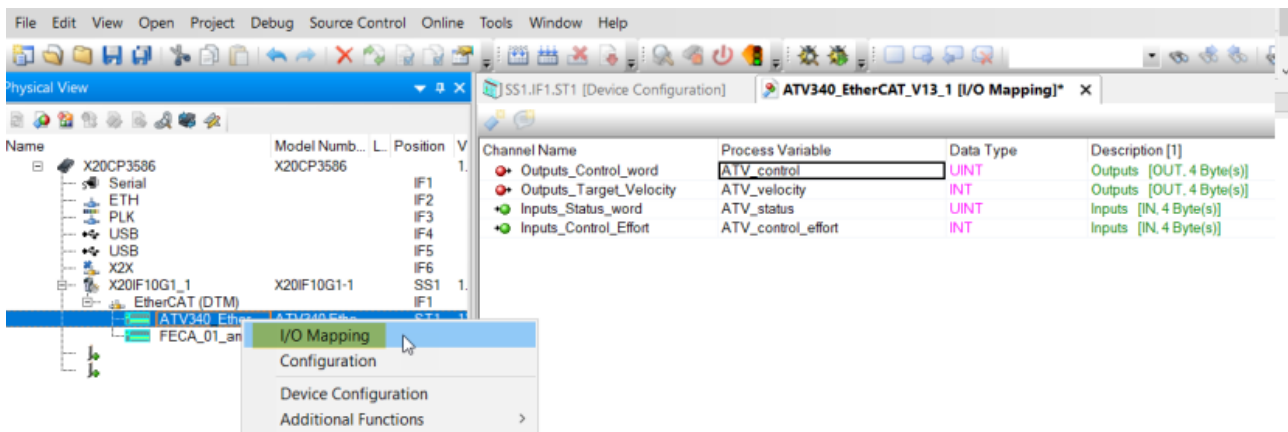
Cancel

Apply

4 配置通道

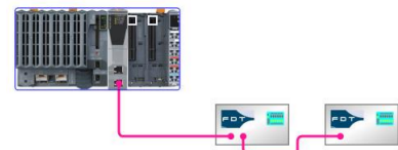
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Ethercat主站模块X20IF10G1-1测试及汇川伺服Ethercat通讯报告

2024-January-24
5/16



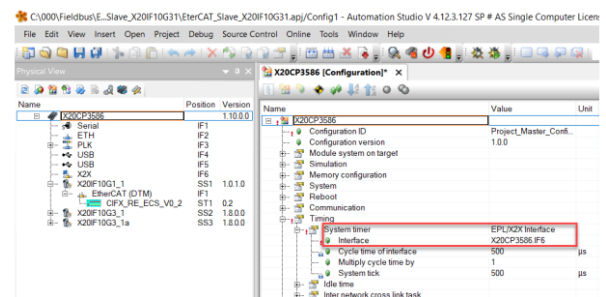
同步模式配置方法：

1. X20IF10G1-1 is on the aPCI Slot in the PLC
&
System timer = X2X interface
&
X2X cycle time = EtherCAT cycle time
&
Synchroninzation mode = DC synchronized
&
Synchronize Timer = on
&
data exchange between CPU and netX = X2X cycle time
&
EtherCAT slave settings ... DC sync = activated



1.

2. X20IF10G1-1 is on the aPCI Slot in the PLC
&
System timer = X2X interface
&
X2X cycle time = EtherCAT cycle time
&
Synchroninzation mode = DC synchronized
&
Synchronize Timer = on
&
data exchange between CPU and netX = X2X cycle time
&
EtherCAT slave settings ... DC sync = activated



2.

X20IF10G1-1 is on the aPCI Slot in the PLC

&

System timer = X2X interface

&

X2X cycle time = EtherCAT cycle time

&

Synchronization mode = DC synchronized

&

Synchronize Timer = on

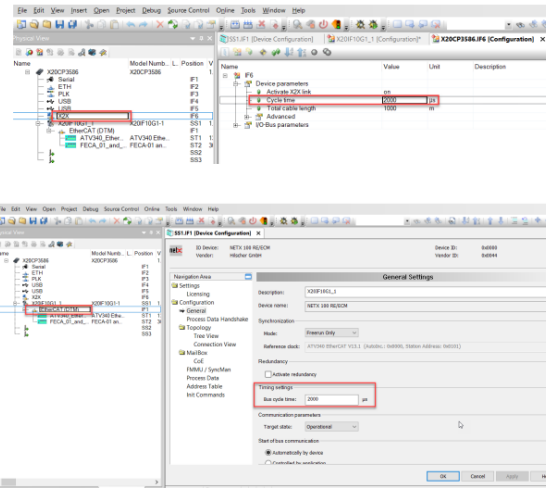
&

data exchange between CPU and netX = X2X cycle time

&

EtherCAT slave settings ... DC sync = activated

3.



X20IF10G1-1 is on the aPCI Slot in the PLC

&

System timer = X2X interface

&

X2X cycle time = EtherCAT cycle time

&

Synchronization mode = DC synchronized

&

Synchronize Timer = on

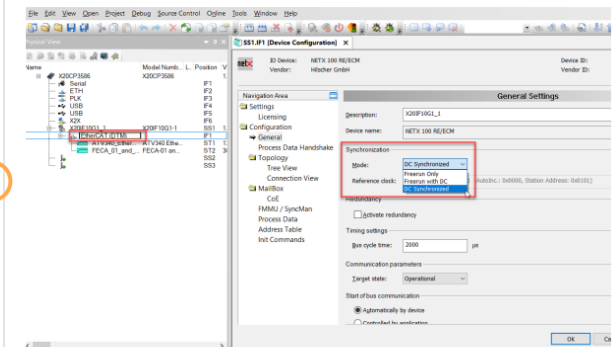
&

data exchange between CPU and netX = X2X cycle time

&

EtherCAT slave settings ... DC sync = activated

4.



X20IF10G1-1 is on the aPCI Slot in the PLC

&

System timer = X2X interface

&

X2X cycle time = EtherCAT cycle time

&

Synchronization mode = DC synchronized

&

Synchronize Timer = on

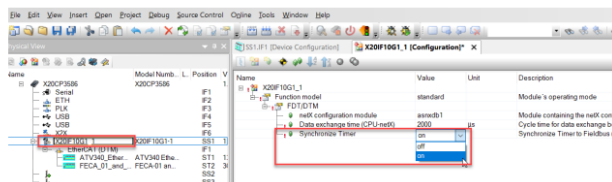
&

data exchange between CPU and netX = X2X cycle time

&

EtherCAT slave settings ... DC sync = activated

5.



X20IF10G1-1 is on the aPCI Slot in the PLC

&

System timer = X2X interface

&

X2X cycle time = EtherCAT cycle time

&

Synchronization mode = DC synchronized

&

Synchronize Timer = on

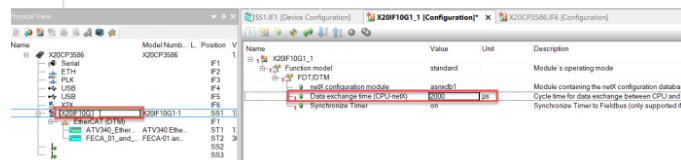
&

data exchange between CPU and netX = X2X cycle time

&

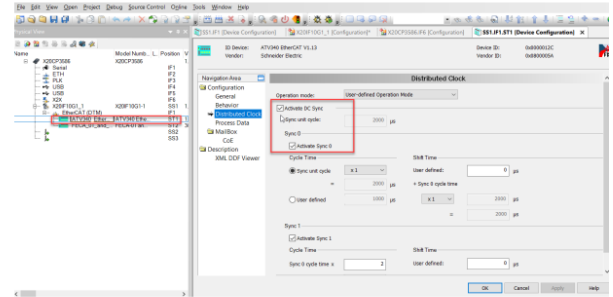
EtherCAT slave settings ... DC sync = activated

6.



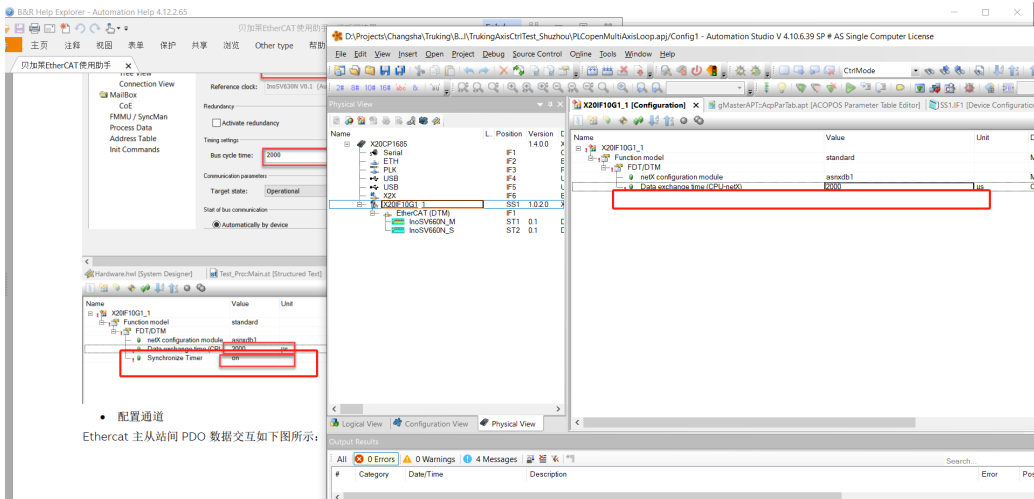
X20IF10G1-1 is on the aPCI Slot in the PLC
&
System timer = X2X interface
&
X2X cycle time = EtherCAT cycle time
&
Synchronization mode = DC synchronized
&
Synchronize Timer = on
&
data exchange between CPU and netX = X2X cycle time
&

EtherCAT slave settings ... DC sync = activated



7.

注意：如出现X20IF10G1-1配置界面没有synchronize timer选项则是AR版本低于E4.93，无法配置同步模式



控制字状态字控制汇川伺服测试

1. 测试环境

AS:4.12

AR:E4.73

PLC: X20CP1586

Servo:SV630N * 2

Motor:MS1H1-10B30CB *2

2. AS配置步骤

- 参考上文配置第三方设备Ethercat通讯步骤：创建项目，添加汇川伺服XML格式文件。硬件拓扑添加X20IF10G1-1模块作为通讯主站后添加第三方Ethercat从站，并设置从站站号

Physical View

Name	Le...	Position	Version	Description
X20CP1586			1.10.0.0	X20 CPU ATOM, 1.6GH
Serial		IF1		Communication Port
ETH		IF2		Ethernet
PLK		IF3		POWERLINK
USB		IF4		Universal Serial Bus
USB		IF5		Universal Serial Bus
X2X		IF6		B&R X2X Link
X20IF10G1_1		SS1	1.0.2.0	X20 Interface EtherCAT
EtherCAT (DTM)		IF1		
InoSV630N_V...		ST1	0.1	DTM generic EtherCAT
InoSV630N_V...		ST2	0.1	DTM generic EtherCAT

- 参考上文配置同步模式方法配置成同步模式，循环时间2000μs

netX

IO Device: NETX 100 RE/ECM
Vendor: Hilscher GmbH

Device ID: 0x0000
Vendor ID: 0x0044

Navigation Area

Settings

Licensing

Configuration

General

Process Data Handshake

Topology

Tree View

Connection View

MailBox

CoE

FMMU / SyncMan

Process Data

Address Table

Init Commands

General Settings

Description: X20IF10G1_1

Device name: NETX 100 RE/ECM

Synchronization

Mode: DC Synchronized

Reference clock: InoSV630N V0.1 (AutoInc.: 0x0000, Station Address: 0x0100)

Redundancy

☐ Activate redundancy

Timing settings

Bus cycle time: 2000 μs

Communication parameters

Target state: Operational

Start of bus communication

☒ Automatically by device

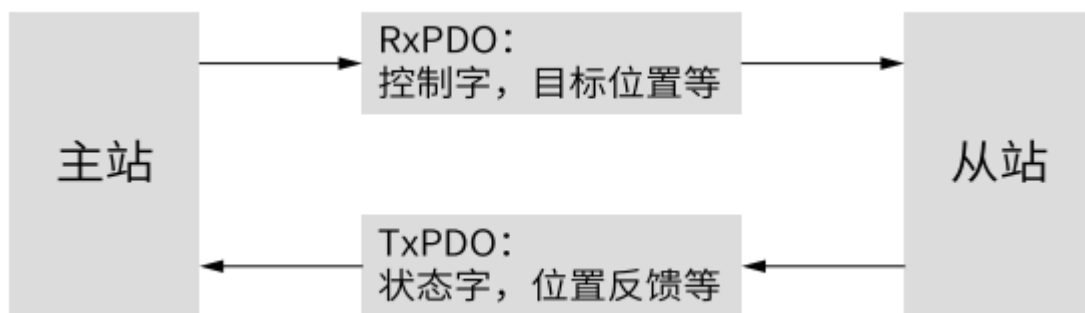
OK Cancel Apply

Hardware.hwl [System Designer] | Test_Proc:Main.st [Structured Text] | X20IF10G1_1 [Configuration]

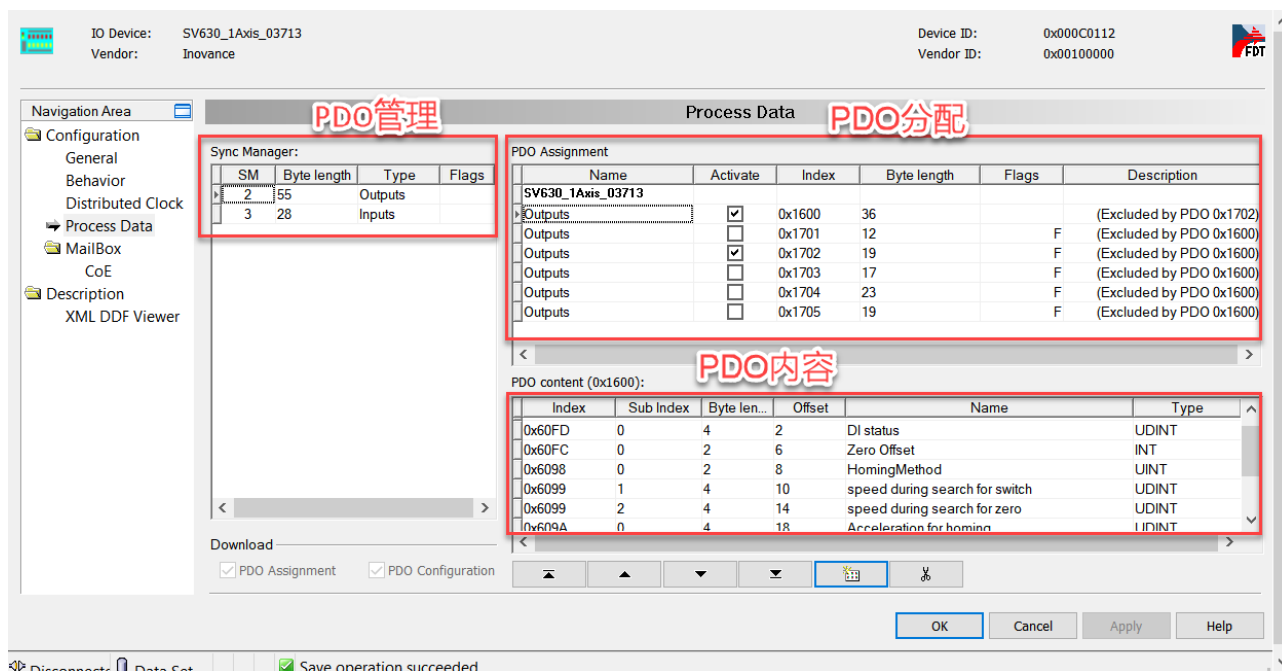
Name	Value	Unit	Description
X20IF10G1_1			
Function model	standard		Module's operating mode
FDT/DTM			
netX configuration module	aspxdh1		Module containing the netX configuration database
Data exchange time (CPU)	2000	μs	Cycle time for data exchange between CPU and netX
Synchronize Timer	on		Synchronize Timer to Fieldbus (only supported if module is operated in

- 配置通道

Ethercat主从站间PDO数据交互如下图所示：



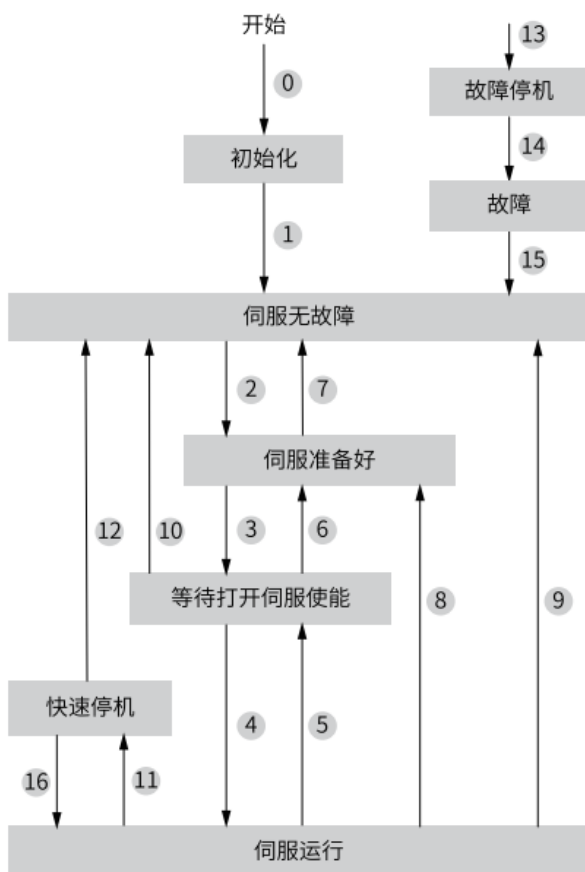
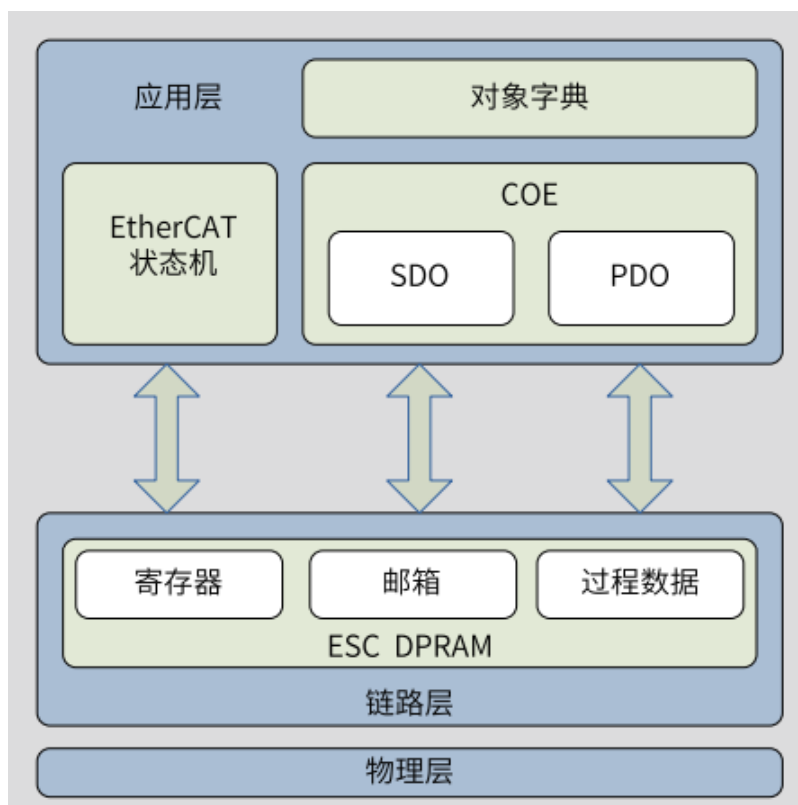
SV630N从站的Process Data本身已有配好的输入输出PDO通道，可直接勾选调用，想再配新通道可在提供的1个可变的RPDO和1个可变的TPDO中分配：PDO分配界面第一个栏目下自行参考伺服配置说明配置，如16#60FD通道对应DI状态。注意映射对象字节不可超过40byte,映射超限会导致驱动器报错。



3. 汇川伺服配置步骤

汇川伺服Ethercat通讯符合IEC 61158 Type 12, IEC 61800-7 CiA 402 Drive Profile标准。在SV630N 伺服驱动器中，采用的是IEC 61800-7 (CiA402)-CANopen 运动控制子协议。

下图是基于CANopen 应用层的EtherCAT 通讯结构以及CiA402状态机切换图。结构图中，在应用层对象字典里包含了：通讯参数、应用程序数据，以及PDO 的映射数据等。PDO 过程数据对象，包含了伺服驱动器运行过程中的实时数据，且以周期性地地进行读写访问。SDO 邮箱通讯，则以非周期性的对一些通讯参数对象、PDO 过程数据对象，进行访问修改。



汇川伺服共有状态显示、参数显示、监控显示、故障显示四种模式可切换，相关参数设置可通过汇川 Inodrivershop 软件进行相关参数设置，也可通过伺服上的操作按钮进行设置，伺服上操作按钮说明以及修改参数方式如下：

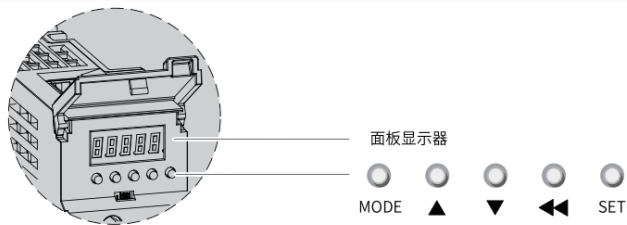
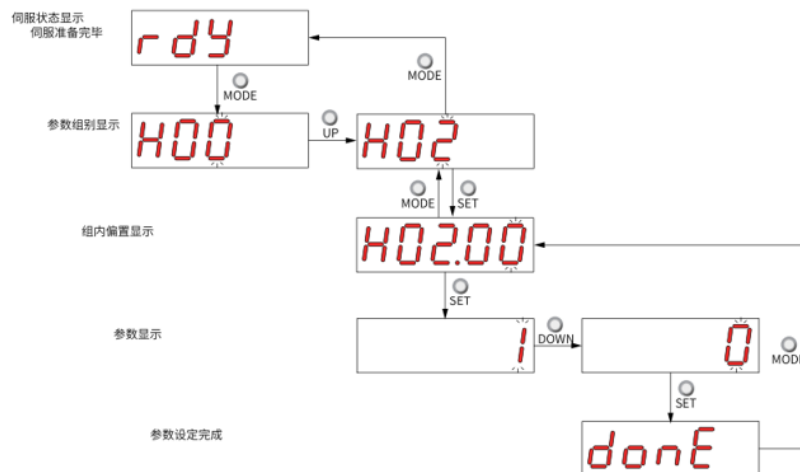


图8-1 面板外观示意图

SV630伺服驱动器的面板由显示器(5位8段LED数码管)和5个按键组成。可用于伺服驱动器的各类显示、参数设定、用户密码设置及一般功能的执行。以参数设定为例，按键常规功能如下表所示：

表8-1 按键常规功能说明

名称	图示	常规功能
MODE键		各模式间切换。 返回上一级菜单。
UP键		增大LED数码管闪烁位数值。
DOWN键		减小LED数码管闪烁位数值。
SHIFT键		变更LED数码管闪烁位。 查看长度大于5位的数据的高位数值。
SET键		进入下一级菜单。 执行存储参数设定值等命令。



Ethercat相关参数配置如下，因默认值符合测试流程，其他不作更改，只需调整伺服站点号与程序匹配。

参数	名称	设定范围	默认值
H02.00h	控制模式选择	0: 速度模式 1: 位置模式 2: 转矩模式 9: EtherCAT模式	9
H0E.02h	通讯写入是否存e2prom	0: 写参数和对象字典时都不保存e2prom 1: 仅写参数时保存e2prom 2: 仅写对象字典时保存e2prom 3: 写参数和对象字典时都保存e2prom 4: 仅通讯建立(OP)前写对象字典时可保存e2prom	4
H0E.21h	EtherCAT从站站点别名	0~65535	0

导入程序后watch对应伺服的IO mapping，通过所开设的PDO通道映射来控制当前伺服运动状态。

Channel Name	Physical Value	ForceActivated	ForceActivated Value
➔ Outputs_Controlword	16#0007	☒	16#0007
➔ Outputs_Modes_of_operation	6	☒	6
➔ Outputs_acc_homing	1000	☒	1000
➔ Outputs_Max_profile_velocity	5000	☒	5000
➔ Outputs_HomingMethod	35	☒	35
➔ Outputs_DI_Status	2#0000_0000_0000_0000_00...	☒	2#0000_0000_0000_0000_0000_0000...
➔ Outputs_res_motor	1000	☒	1000
➔ Outputs_res_axis	100	☒	100
➔ Outputs_s_for_switch	1000	☒	1000
➔ Outputs_s_for_zero	1000	☒	1000
➔ Inputs_Statusword	2#0000_0110_0011_0011	☐	2#0000_0000_0000_0000
➔ Inputs_Position_actual_value	-1534	☐	0
➔ Inputs_Touch_probe_status	0	☐	0
➔ Inputs_Touch_probe_pos1_...	0	☐	0
➔ Inputs_Touch_probe_pos2_...	0	☐	0
➔ Inputs_Error_code	0	☐	0
➔ Inputs_Digital_inputs	0	☐	0

SDC方式控制汇川伺服测试

在上一章节的基础上继续使用IF10G1-1主站模块通讯汇川伺服SV630N来控制汇川电机，这次采用SDC轴方法来控制。

软件版本：AS: 4.12 AR: E4.73 ACP10: 5.18.1

1. 配置软件环境

首先Runtime version配置中添加ACP10，并且在库文件中添加Acp10sdc库，添加好后库文件情况如下图所示。

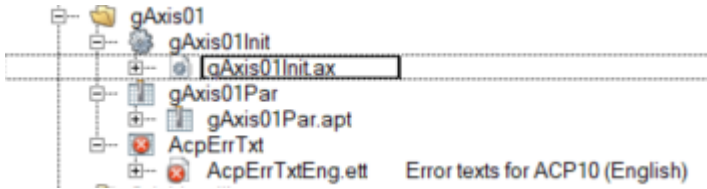
Libraries	Global libraries
operator	This library contains function interfa
runtime	This library contains runtime functi
astime	The AsTime Library supports DAT
AslecCon	This library contains function interfa
NcGlobal	Global NC functions
sys_lib	The SYS_LIB library contains funct
AsBrStr	The AsBrStr Library contains FBKs
brsystem	The BRSystem library provides the
Acp10man	Motion Control Manager
Acp10par	ACOPOS Parameters
Acp10sdc	Smart Device Controller
Acp10_MC	PLCopen Motion Control function b
Acp10sim	ACOPOS Simulation

2. 添加SDC接口

在Configuration View中添加NC Configuration表，并且在表中添加SDC接口

Name	Value	De
Configuration data for ACP10		
Number of data records per ACOPOS for Network Command Trace	150	
Size of data buffer for trace data upload [Bytes]	1200	
Task class for NC Manager task	Cyclic #1	
Use global PV as NC object	Yes	
Enable NCSYS download via broadcast	Yes	
ACOPOS reset after NCSYS download	Yes	
Enter SafeMC Logger errors into axis structure	Yes	
Network initialization (ACOPOS startup)		
Execute at NC software initialization	Yes	
Execute automatically after ACOPOS reset	No	
Warning for non-ascending node numbers (only for POWERLINK)	Yes	
Indicate network errors before first NC action (only for POWERLINK)	Yes	
Network Command Trace		
Enter Parameter Sequence records	Yes	
Enter PLCopen and NC function calls	Yes	
Save start index of ring buffer after network initialization (ACOPOS startup)	No	
Cam Profile Download		
Parallel transfer of Cam profile data	No	
Reference task class for parallel transfer	Task class for...	
Smart Device Controller (SDC) interface[0]		
Interface name	SDC_IF1	
Size of ACP10_MC_BROADCAST [Bytes]	800	
Extended coupling data for ACP10_MC_BROADCAST	No	

3. 添加轴配置



4. 添加NC Mapping表并定义SDC轴

AS4.2及以上版本，默认的ncm文件中无法自由添加轴，所以我们新建一个ncm文件并加入一根SDC轴，配置好相关参数。在Configuration View中添加新的NC Mapping表，在表中定义SDC轴对象，并且指明SDC的配置变量。在.ncm文件中，通过“SDC_AX_HwPv=“xxx [x]”，将软件程序中的SDC轴硬件配置接口变量xxx [x]分配给SDC轴（gSdcAxisCtrl.cfg.sdcHwCfg[x]），与实际硬件建立连接。完成后在全局变量中添加轴声明。

NC Object Name	PLC Address	Nc Obj...	Channel	Simulat...	NC INIT Parameter	ACOPOS Parameter	Additional Data
gAxis01	SDC_IF1.ST1	ncAXIS	1	Off	gAxis01Ini	gAxis01Par	SDC_AX_HwPv="gSdcAxisCtrl.cfg.sdcHwCfg[0]"
gAxis02	SDC_IF1.ST2	ncAXIS	1	Off	gAxis01Ini	gAxis01Par	SDC_AX_HwPv="gSdcAxisCtrl.cfg.sdcHwCfg[1]"

5.配置SDC程序

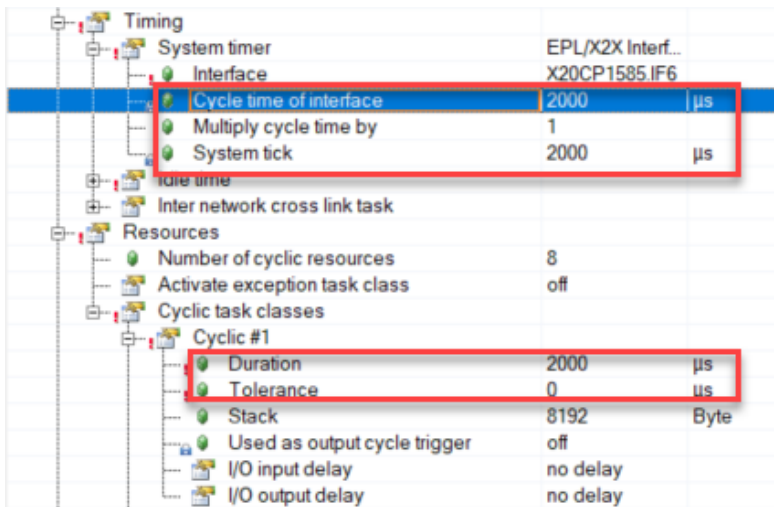
添加对应第三方设备对象字典的SDC范例程序，本次测试采用汇川SV630N的SDC程序进行。因SV630N驱动器无插补模式，例程中默认选用周期同步位置模式。

SV630N_SDC.zip

```
////
////
////Cia 402 控制字请勿修改*/
//define CONTROLWORD_AND_MASK 0x01FF /* 0000 0001 1111 1111 - 6运算保留bit=1*/
#define CONTROLWORD_READY_TO_SWITCH_ON 0x0006 //0110 十进制6
#define CONTROLWORD_SWITCH_ON 0x0007 //0111 十进制7
#define CONTROLWORD_OPERATION_ENABLE 0x000F //0001 1111 十进制15
#define CONTROLWORD_FAULT_RESET 0x0080 //1000 0000 十进制128: Bit7上升沿故障复位
////
////
////状态字定义 (60410010h)
//
Bit0:Ready to switch on //0: 无效, 1: 有效,有效时表示 伺服准备好
Bit1:Switched on //0: 无效, 1: 有效,有效时表示 可以开启伺服运行
Bit2:Operation enabled //0: 无效, 1: 有效,有效时表示 伺服运行状态
Bit3:伺服故障 //0: 无故障, 1: 有故障
Bit4:Voltage enabled //0: 无效, 1: 有效,有效时表示 接通主回路电压
Bit5:快速停机 //0: 快速停机有效, 1: 快速停机无效
Bit6:Switch on disabled //0: 无效, 1: 有效,有效时表示 伺服不可运行
Bit7:警告 //0: 无警告, 1: 有警告
Bit8:厂家自定义 //暂无
Bit9:远程控制 //0: 无效, 1: 有效,有效时表示控制字已生效
Bit10:位置到达 //(60400010h bit 8 (暂停)=0, 0: 位置未到达, 1: 位置到达; 60400010h bit 8 (暂停)=1, 0: 减速中, 1: 速度为0)
Bit11:内部软限位状态 //0: 没有到达软限位, 1: 到达软限位
Bit12:从站跟随指令 //
Bit13:跟随误差 //暂无
Bit14:厂家自定义 //暂无
Bit15:回原点完成 //0: 无效, 1: 已完成回原点。
```

注：任务循环设置

默认配置中，SDC需要在Task Class #1 中运行，因此需要把这个任务等级的Tolerance改为0；另外，任务周期不能大于10ms。



6. 添加单轴程序测试

最后，调用单轴程序并关联轴来进行轴控制

File	Modified
 image2023-5-19_12-44-58.png	2023-05-19 by Siyao Hu1
 image2023-5-19_12-46-40.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-7-51.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-9-36.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-15-56.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-18-26.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-19-1.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-19-41.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-20-28.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-21-1.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-21-27.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-21-46.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-32-46.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-37-49.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-38-8.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-39-20.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-40-22.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-49-52.png	2023-05-19 by Siyao Hu1
 image2023-5-19_13-54-20.png	2023-05-19 by Siyao Hu1
 image2023-5-19_14-3-41.png	2023-05-19 by Siyao Hu1
 image2023-5-19_14-11-22.png	2023-05-19 by Siyao Hu1
 image2023-5-19_14-12-15.png	2023-05-19 by Siyao Hu1
 image2023-5-19_14-14-28.png	2023-05-19 by Siyao Hu1
 image2023-5-19_14-24-0.png	2023-05-19 by Siyao Hu1
 image2023-5-19_14-25-42.png	2023-05-19 by Siyao Hu1
 image2023-5-23_9-21-23.png	2023-05-23 by Siyao Hu1
 image2023-5-23_15-35-21.png	2023-05-23 by Siyao Hu1
 image2023-6-21_15-11-28.png	2023-06-21 by Siyao Hu1
 image2023-7-6_13-20-33.png	2023-07-06 by Siyao Hu1

File	Modified
 image2023-7-6_13-22-53.png	2023-07-06 by Siyao Hu1
 image2023-7-6_14-13-46.png	2023-07-06 by Siyao Hu1
 image2023-7-6_14-14-48.png	2023-07-06 by Siyao Hu1
 image2023-7-6_14-36-19.png	2023-07-06 by Siyao Hu1
 image2023-7-6_14-37-15.png	2023-07-06 by Siyao Hu1
 image2023-7-6_14-49-36.png	2023-07-06 by Siyao Hu1
 SV630N_SDC.zip	2023-07-06 by Siyao Hu1
 image-2023-11-21_10-34-58.png	2023-11-21 by Siyao Hu1