

ETAL TEMPERATURE CN

ETAL 温度控制模型(CN)用户手册

Date: June 13, 2018

Project Num- ETAL-TEMPERATURE-CN ber:

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I Versions

Version	Date	Comment	Edited by
1.0	June 6, 2018	First Edition	Zhouj

Table 1: Versions

II Distribution

Name	Company, Department	Amount	Remarks

Table 2: Distribution

III Safety Notices

Safety notices in this document are organized as follows:

Safety notice	Description
Danger!	Disregarding the safety regulations and guidelines can be life-threatening.
Warning!	Disregarding the safety regulations and guidelines can result in severe injury or heavy damage to material.
Caution!	Disregarding the safety regulations and guidelines can result in injury or damage to material.
Information:	Important information used to prevent errors.

Table 3: Safety notices

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1 介绍

ETAL 温度控制模型用于模拟工业生产中多温区测量和控制系统。这类多输入多输出被控对象,同时具有强耦合性、非线性和变参数等不利于控制的特性。

ETAL 温度控制模型由两部分组成,PLC 控制器部分和温度控制部分。其中 PLC 控制器部分主要为 B&R X20 系列标准型 CPU X20CP1584;而温度控制部分由 B&R X20 系列 IO 模块,以及温度控制模型本体构成。

利用 B&R 控制系统的开放性,除了使用工业控制行业常用的 PID 控制策略进行控制之外,也可以尝试使用各种现代控制理论进行多温区控制算法的基础研究并在模型上得到验证。



2 安全须知

- 请使用配套的电源线
- 请使用民用 220V 交流电源供电
- 检查所有接线是否有松动
- 请勿触碰裸露的接线部件
- 请勿触碰加热组件
- 请勿在无人照看的情况下使用该装置
- 持续加热可能会导致硬件的损坏、甚至火灾

3 快速指南

3.1 主要部件介绍





PLC 控制器部分与温度控制部分通过 POWERLINK 工业以太网相互连接,PLC CPU 控制器作为 POWER-LINK 主站,而温度控制部分中的 X20BC0083 模块及其后携带的 I/O 模块作为 POWERLINK 的从站。 PLC CPU 控制器主要实现自动化程序的实现以及对 POWERLINK 从站 I/O 模块的控制;温度控制部分的 I/O 模块实现对传感器(测温热电偶)及执行器(风扇和加热管)的连接与控制,并将这些信息通过 X20BC0083 总线控制器,以 POWERLINK 协议通讯的方式与 PLC CPU 控制器交互。温度控制部分的模型 则模拟了三个温区的加热控制对象,通过调节加热管和风扇的输出,可以控制被加热对象的温度高低;同 时每个温区的三个不同位置的热电偶可检测这些区域的温度,构成了一个闭环控制系统。

3.2 使用简介

3.2.1 使用前检查

电源线:检查 PLC 控制器部分和温度控制部分各自的 220VAC 电源线与其 24VDC 电源连接是否紧固,没 有松动;

POWERLINK 连线:检查 PLC 控制器上的 IF3 POWERLINK 工业以太网 RJ45 接口处的连线是否紧固,且 与温度控制部分的 X20BC0083 模块的 POWERLINK 工业以太网 RJ45 接口处的连线是否接紧固没有松动。

以太网连线:检查 PLC 控制器上的 IF2 Ethernet 以太网 RJ45 接口处的连线是否紧固;

I/O 模块接线:检查温度控制部分的 X20BC0083POWERLINK 从站各个 I/O 模块的连线是否紧固没有松动, I/O 模块的端子是否与模板紧密连接没有松动。

3.2.2 上电检查

将 PLC 控制器部分和温度控制部分的电源线各自接入 220VAC 插座后,两个部分得电后开始启动。

3.2.2.1 PLC 控制部分

- 24VDC 供电电源的 LED 指示灯由暗转蓝;
- PLC CPU 的状态指示灯(见 4.1.3.1.3 节)按如下规律闪亮:
 - 1. 上电后 DC 灯黄色常亮(电池存在的情况下);
 - 2. CF 灯黄色绿色交替闪亮;
 - 3. ETH 及 PLK 灯闪亮 (如果 PLK 连接了 X20BC0083 从站模块, ETH 也连接了计算机);
 - 4. RDY/ F 黄色常亮;
 - 5. S/E 灯闪烁后绿色常亮;
 - 6. R/E 灯闪烁;
 - 7. R/E 灯常亮且 RDY/E 灯关闭;

启动完毕后 LED 状态灯为: R/E 绿色常亮, S/E 绿色常亮, PLK 和 ETH 绿色闪烁, CF 绿色常亮, DC 黄色常亮。

3.2.2.2 温度控制部分

- 24VDC 供电电源 LED 指示灯亮(由于在背后较少观察);
- X20BC0083 :
- 1. S/E 灯快速闪烁;
- 2. L/A IFx 快速闪烁,并且 S/E 灯转为绿色常亮;

其他模块:

r 灯闪烁 , 待 X20BC0083 启动完毕后 r 灯常亮 , 其中 X20AT6402 上有连接传感器的通道对应的数字状态 灯会常亮。

3.2.3 Automation Studio 连接与调试

以第一次使用 Automation Studio 新建工程项目为例,解释如何在 Automation Studio 对本模型进行简单的项目创建与调试。

3.2.3.1 Automation Studio 的下载、安装及注册

Automation Studio 的下载、安装及注册,请参见相关 Automation Studio 安装和注册的说明文档。

3.2.3.2 计算机的以太网 IP 地址设置

计算机与 PLC 控制器一般通过以太网连接进行连接、编程下载及调试。所以安装有 Automation Studio 的计算机需要设定一个有效的 IP 地址,以便之后与 PLC CPU 模块进行通讯连接。

注意:以下设定仅在使用计算机与 PLC 使用网线直接连接时有效; IP 地址的设定请不要和计算机的其他网络中的设定冲突。

1. 打开控制面板中网络和共享中心中的 LAN 连接属性,打开 IPv4 的设置:

Local Area Connection Properties	23		
Networking Authentication Sharing			
Connect using:			
Intel(R) Ethemet Connection I217-LM			
Configure			
This connection uses the following items:			
 Client for Microsoft Networks Juniper Network Service QoS Packet Scheduler File and Printer Sharing for Microsoft Networks Internet Protocol Version 6 (TCP/IPv6) Internet Protocol Version 4 (TCP/IPv4) 			
Install Uninstall Properties			
Description Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.			
ОК Саг	ncel		

ternet Protocol Version 4 (TCP/IPv4	1) Properties	
General		
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.		
Obtain an IP address automatic	ally	
• Use the following IP address: -		
IP address:	192 . 168 . 1 . 101	
Subnet mask:	255 . 255 . 255 . 0	
Default gateway:		
Obtain DNS server address auto	omatically	
Ouse the following DNS server according to the serv	ddresses:	
Preferred DNS server:		
Alternate DNS server:	• • •	
Validate settings upon exit	Advanced	
	OK Cancel	

2. 将 IP 地址手动设定为 192.168.1.101, 子网掩码为 255.255.255.0

3. 确认并关闭后, 计算机即按设定的 IP 地址工作, 为之后的连线做准备。

3.2.3.3 新建 Automation Studio 项目

1. 打开 Automation Studio,使用 File -> New Project...新建项目

Automation Studio - New Project Wizard In this screen please enter the base parameters for the new project. Name of the project:	~
Name of the project:	
TempControl	
Path of the project:	
C:\projects\	
Note: A subfolder with the same name as the project will be created automatically.	
Copy Automation Runtime files into project	
Description of the project:	
Next > Cancel Hel	p

2. 在 Name of the configuration 中填写配置名称,比如 CP1584;选择 Define a new hardware configuration manually 并点击 Next。

New Project		<u> </u>
Automa In this scree	n please enter the parameters of the new configuration.	*
	Name of the configuration:	
5	CP1584	
	Hardware Configuration	
	Operation of the second sec	
	Identify hardware configuration online	
	Reference an existing hardware configuration (*.hw).	
	Description of the configuration:	
	< Back Next > Cancel H	lelp

3. 在 Catalog 中的搜索栏输入 X20CP1584,如此可以在列表中筛选出我们要添加的 PLC CPU X20CP1584。点击 Finish 就可以完成项目的新建。

New Project	-232
Automation Studio - New Project Wizard In this screen select the CPU or system unit you want to use.	
Catalog Favorites Recent Catalog Favorites Recent Catalog Favorites Recent Catalog Favorites Recent Controller Controller Controller Controller	
Name Description X20CP1584 X20 CPU ATOM, 0.6GHz, POWERLINK, 1x IF	
Activate Simulation Automation Runtime type: AR Embedded < Back Finish Cancel Help	•

3.2.3.4 添加硬件模块

在新建的 X20CP1584 项目中,还需要增添温度控制部分的 X20BC0083 及其后连接的 I/O 模块。

1. 首先在 Automation Studio 整个界面左侧的 Project Explorer 中选择 Physical View,选中 X20CP1584 下的 PLK 即 POWERLINK 接口:



2. 在右侧的 Toolbox – Hardware Catalog 中输入 X20BC0083,在列表中能筛选到 X20BC0083。使用 鼠标左键选中它,并通过拖曳的方式添加到当前的 PLK 接口中。



可以看到,配置了 X20BC0083 后,对应的电源模块 X20PS9400 和 X20BB80 都会被自动加载到当前配置中。

3. 同样,可以选择 X20BB80 下的 X2X 接口,以便添加后续的 IO 模块,请依次添加 X20DS1119、 X20DO4332 和两块 X20AT6402。

😤 C:\projects\TempControl\TempControl.apj/CP1584 - Automa	tion Studio V 4.3.6.57 SP # AS Site License (Legacy)		
File Edit View Open Project Debug Source Control	Online Tools Window Help		
🗄 🔂 😋 📮 🛃 🕼 🧏 🕼 👘 🗠 🔶 🗙 🗞	🖀 📜 🛗 🛗 🔍 🔍 🌒 🖉 🖉 🕌 🕌 🕌 🗐 💭 🦓 🚛	- 무 후 후 .	• 🗞 🗞 🚦
Physical View 🗢 📮 🗙		Toolbox - Hardware Catalog (X20A1	(6402a) ▼ ₽ ×
		Catalog Favorites Recent	
Name L Position		i 🚳 i 🖩 📲 😽 🤸 🗙	6402 ×
A 20CP1584		Product Group	
🚽 🚽 🐨 🖓 Serial 🛛 👘 IF1			
ETH IF2			
		1/0	
X20B00 S11			
		I/O	
🖕 💑 X2X 🛛 🛙 IF1			
🐁 X20DS1119 ST2			
🕵 X20DO4332 ST3		Temperature	
X20A16402 S14			
ISB IF4			
🐁 X2X IF6			
		Name De	escription
		X20AT6402 X2	20 Analog 6xl, THERMOCOU
		X20cAT6402 X2	20c analog 6xl, THERMOCOI
۰ III ۲			
🔥 Logical View 🛛 🏘 Configuration View 🗬 Physical View		•	•

请注意添加的顺序和模块的型号务必于及时使用的模块型号及安装循序完全一致。

3.2.3.5 配置 CPU 控制器的以太网属性

需要对项目中 CPU 的以太网接口配置 IP 地址和子网掩码,这样才能使得运行后能与计算机正确建立连接。

1. 在 Physical View 中,选择并点击 X20CP1584 下的 ETH 接口,选择 Configuration



- 2. 在 Mode 中选择 enter IP address manually
- 3. 将 IP 地址设定为 192.168.1.100, 子网掩码 255.255.255.0

1 X20CP1584.IF2 [Configuration]* ×			•
🔠 📎 🔶 🖗 🎝 🛣			
	Value	Unit	Description A
Antiunto interface			
Reducter parameter	Single CPLL Project		
	Single CF0 Project		Fac alabal Eth
Jungie CFO parameters	br automation		For global Elli
Prud este	pracomation		
Mada	enter IP address manually		
	102 100 1 100		
Gubest Made	152,100,1,100		Ξ
	200.200.200.0		
	an.		
Activate online communication	11150		
	Single CBU		
	Single CFU		
Anyor parameters			
VINC Server	on		
Provide a la contracta a contr			
VC object name			
Ney mapping tile			
Passwords	-8		
	017 5000		
Port number	3300		Maria
Max. connections	/		Maximum allo

3.2.3.6 添加程序及变量申明

1. 在 Project Explorer 中选择 Logical View,选择当前项目的根目录即 TempControl,在右边的 Toolbox – Object Catalog 中选择 Program,我们以添加 ST 语言的程序为例,选择 ST Program 或 者 ST Program All in One。

* C:\projects\TempControl\TempCor	ntrol.apj/CP1584 - Automation Studio V 4.3.6.5	i7 SP # AS Site License (Legacy)		
File Edit View Insert Open	Project Debug Source Control Online	Tools Window Help		
i 🖞 🖓 😂 🖶 👰 🛸 🖓 👘 I	ちゃ X 🕸 🗟 🕼 🖀 📇	BIG 40 1 BABIO] 4 5 8	• 🐟 🗟 😓 💾
Logical View 👻 🕈 🗙	X20CP1584.IF2 [Configuration]* X		Toolbox - Object Catalog	→ ↓ ×
	🤐 🗞 🔺 🏘 🗛 🏦		🗄 🕅 👻 Search	م
Object Name Desc			Programmable Object Units	*
TempControl		Value		
Global.typ Global	Activate interface			
🕀 🧭 Global.var Globi	Redundant parameter	Single CPU Project	Program	
	→ Single CPU parameters			
	Host name	br-automation		
	🖗 Baud rate	auto		
	🖕 📩 Mode	enter IP address manually		
	🛛 👔 🖗 IP address	192.168.1.100		
	Subnet Mask	255.255.255.0		
	INA parameters			
	Activate online communication	11150		
	+ Redundant INA configuration	Single CPU	Name	Description ^
	ANSL parameters		ANSIC++ Program All In O	Program in ANSI C++
	Activate online communication	on	GFC Program	Program in Continous
	Servers VNC Servers		Existing Program	Existing program
	- VNC Server 1		FBD Program	Program in Function [
	VC Mapping		IL Program	Program in Instruction
	VC object name		IL Program All in One	Program in Instruction Program in Ladder
	Key mapping file		ACTION Diagram Program	Program in reACTION
	Passwords	off.	SFC Program	Program in Sequentia
	Part number	5900	🚽 ST Program	Program in Structured
	Max. connections	1	🚽 🚽 ST Program All In One	Program in Structured
🔒 Logica 🏘 Confi 🛛 🛷 Physic	· · · · · · · · · · · · · · · · · · ·		×	•
Output Results		▼ ₽ × Properties - X20CP1584.IF2		▲ 廿 ×
All 😣 0 Errors 🗛 0 Warnings	🚺 3 Messages 🛛 🞽 派	_ 🖉 🍏		
3 Items (Selected : 0)			р. <u>МШ.</u> р.:	
🚰 O 🔟 O 👹 De 🖓 Fi 👔	😼 Ca 🔂 De 🎕 Co 👿 Br 🛛 💷 Cr	Re 🕢 I/O Mapping 😭 Configura	ration	
For Help, press F1		tcpip/RT=1000 /SDT=5	/DAIP=10.86.12.102 /REPO=11159 /ANS	L=1 /PT= OFFLIN

2. 我们可以把任务名称改写为 IOvar,在这个任务中我们会定义所有输入输出模块通道需要定义的变量值,以便和 I/O 的输入输出的物理值作好对应关系(IOmapping)。

😤 C:\projects\TempControl\TempControl.apj/CP1584 - Automation Studio V 4.3.6.57 SP # AS Site License (Legacy)										
File Edit View Insert Open	Project Debug Source Control C	Online Tools Window	Help							
: 🖓 😋 😂 📲 🕌 🖄 🗇 🐂 🖉 🖓 🖓 🖓 📲 🛗 🖓 🖄 🕌 🗒 🖉 🖉 🖉 🖉 🖉 🖉 🖉 🖉 🖉 👘 👘 🖓 🖓 📲										
Logical View 🔻 🖵 🗙	1 X20CP1584.IF2 [Configuration]	IOvar::Variables.var (Variab	ble Declaration 1	t IO::Main.st [Stru	uctured Text1		- 52			
	~ @						97			
Object Name	Name	Tuno	Pefermana	O Coortort	C Detain	Popliashla	Value			
Given and a second		INT			Hetain		value			
🕀 🕂 🚯 Global.typ	at Temp_Zone01_CH02	INT					6			
🖶 💮 Global.var	atTemp_Zone01_CH02	INT					je.			
Durar		INT					Ct C			
⊢ 😝 IOVar	at Temp Zone02 CH02	INT					at			
		INT								
🗄 📈 🚺 Variables.var 🖊	atTemp_Zone03_CH01	INT								
	atTemp_Zone03_CH02	INT								
	atTemp_Zone03_CH03	INT]							
	doTemp_Zone01	BOOL								
	doTemp_Zone02	BOOL								
	doTemp_Zone03	BOOL								
	🧼 doCoolingFan	BOOL								
<										
🔒 Logica 🦂 Confi 🛹 Physic	•	III					F.			

3. 在本例中,我们在 ST 语言的初始化任务中添加变量赋值代码段,以便将之前的变量申明在程序里实例 化,才能确保变量的正确映射及能在系统中调用。

```
😹 IOvar::Main.st [Structured Text] 🗙 📝 IOvar::Variables.var [Variable Declaration]
                                                                                                                                                                                                                                                Ŧ
🕫 🧳 🚠 🖬 🗐 🚊 🖆 🗰 📄
 👒 _INIT
                                                                                                                                                                                                                                                •
                                                                                                                                                                                                                                                .
      - PROGRAM INIT
                   (* Insert code here *)
                  atTemp_Zone01_CH01 := atTemp_Zone01_CH01; //温区一温度(下)
atTemp_Zone01_CH02 := atTemp_Zone01_CH02; //温区一温度(中)
atTemp_Zone01_CH03 := atTemp_Zone01_CH03; //温区一温度(上)
atTemp_Zone02_CH01 := atTemp_Zone02_CH01; //温区二温度(下)
atTemp_Zone02_CH03 := atTemp_Zone02_CH02; //温区二温度(中)
atTemp_Zone03_CH01 := atTemp_Zone02_CH03; //温区二温度(上)
atTemp_Zone03_CH01 := atTemp_Zone03_CH01; //温区三温度(下)
atTemp_Zone03_CH02 := atTemp_Zone03_CH01; //温区三温度(下)
atTemp_Zone03_CH03 := atTemp_Zone03_CH02; //温区三温度(中)
atTemp_Zone03_CH03 := atTemp_Zone03_CH03; //温区三温度(上)
atTemp_Zone01 := doTemp_Zone01; //温区一加热
                                                                                                                                                                                                                                                =
                                                                                                                          doTemp_Zone03 concost : doTemp_Zone01;
doTemp_Zone01 := doTemp_Zone02;
doTemp_Zone03 := doTemp_Zone03;
doTemp_Zone03 := doCoolingFan;
                                                                                                                           //温区二加热
                                                                                                                          //温区三加热
                                                           := doCoolingFan;
                                                                                                                             //冷却风扇
                   doCoolingFan
          END PROGRAM
      PROGRAM _CYCLIC
                    (* Insert code here *)
                                                                                                                                                                                                                                              F H + F H
          END PROGRAM

    PROGRAM _EXIT

       code here *1
   ≡
                                                                                                              111
```

3.2.3.7 I/O 模块的配置

因为有些 I/O 模块具有多种不同功能或者工作模式,所以需要对 I/O 模块进行一定的设置才能让其按照当前的应用情况下工作。可以在 Physical View 中的模块上点击右键,打开 I/O Configuration 进行设置。 配置完成之后就可以映射之前在程序中申明的变量。如此应用程序就可以获取输入模块各个通道的输入状态,以及设定输出模块各个通道的输出状态。

1. 右键点击模块,在弹出的菜单栏中点击 Configuration,即可打开该模块的 I/O Configuration



以下各模块的 I/O Configuration 配置如下:

X20DS1119:

	Veha	11-3	Desertation
	value	Unit	Description
E	default		Module operating mode
W Module supervised	on		Service mode if there is no hardware mod
🖗 Supply information	off		Additional information of power supplies
🖗 SDC information	off		Additional SDC information
····· 🖗 Network information	off		Additional network information
📦 SI-frame generation	X2X cycle optimized		Cycle for generating SI-frame
🖃 🚥 🚰 System timer			
····· 📦 Cycle time	100		Cycle time in us (25255us)
🖗 Cycle prescaler	2		Multiples of system timer
🦾 😡 Cycle offset	0		Cycle offset in us (-40964095us)
🗄 🔤 Physical I/O channel configuration			
🐂 🖗 Configuration channel 01	output push/pull		Select operating mode input/output chan
····· 🖗 Output control channel 01	direct I/O handling		Select control source
🖗 Configuration channel 02	input		Select operating mode input/output chan
🖗 Output control channel 02	direct I/O handling		Select control source
🖗 Configuration channel 03	input		Select operating mode input/output chan
🖗 Output control channel 03	direct I/O handling		Select control source
····· 🖗 Configuration channel 04	input		Select operating mode input channel
🖗 Configuration channel 05	input		Select operating mode input channel
🖃 📲 I/O handling			
🖃 📲 Direct I/O			
🖃 📲 Direct I/O handling	on		De-/activate direct I/O handling
Read input status	on		Select if input channels are used
🖗 Output update cycle	X2X cycle optimized		Cycle for output update
Direct control of output channel 01	default		Select operating mode of output
📦 Direct control of output channel 02	default		Select operating mode of output
Direct control of output channel 03	default		Select operating mode of output
🖃 🖷 🚰 Oversampled I/O			
	off		De-/activate oversampled I/O handling
Edge detection			
Edge detection	off		De-/activate edge detection
E Movement			_
	off		De-/activate movement
Em SSI encoder			
Film M Encoder	off		De-/activate SSI
	off		Select counter mode
	90		Server counter mous

X20DO4332

使用默认的配置即可,无需修改:

T20D04332 [Configuration] ×									
Name	Value	Unit Description							
🖃 😭 X20DO4332									
🗄 🚰 Function model	default	Module operating mode							
🖕 😁 General									
🖗 Module supervised	on	Service mode if there is no hardware module							
🖗 Output status information	on	Additional output status information							
Packed outputs	off	Packed I/O data instead of single digital outputs							

X20AT6402

因两块 X20AT6402 连接的热电偶数量不同,所以配置分别如下:

第一块 X20AT6402:

Name			Value	Unit	Description
🖃 🛔 🔛 🖂	T6402				
ė į 🚰	Function	model	internal compensa		Module operating mode
ė… ,	🚰 Ger	neral			
	🎯	Module supervised	on		Service mode if there is no hardware module
	🃦	IO cycle counter	off		IO cycle counter
	🎯	Input Filter	20 ms		Input Filter
	🖗 Environment Type		Standard		Thermal environment model
	<u>,</u> 🌒	Sensor type	К		Sensor type
	¥	Sensor type Disable channel 01	K		Sensor type Selectively disabling of not used channels reduces the module cycle time
		Sensor type Disable channel 01 Disable channel 02	K off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
	••••••••••••••••••••••••••••••••••••••	Sensor type Disable channel 01 Disable channel 02 Disable channel 03	K off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
		Sensor type Disable channel 01 Disable channel 02 Disable channel 03 Disable channel 04	K off off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
	9 	Sensor type Disable channel 01 Disable channel 02 Disable channel 03 Disable channel 04 Disable channel 05	K off off off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
	······································	Sensor type Disable channel 01 Disable channel 02 Disable channel 03 Disable channel 04 Disable channel 05 Disable channel 06	K off off off off off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time

第二块 X20AT6402:

因为第4至第6通道没有连接热电偶,所以在 Configuration 中禁用了这三个通道。

Name			Value	Unit	Description
ं 🗉 👔 🕄 🕻	X20AT6402a				
Ė	Function	model	internal compensa		Module operating mode
	🗄 👔 🚰 Gen	neral			
	🎯	Module supervised	on		Service mode if there is no hardware module
	🎯	IO cycle counter	off		IO cycle counter
	🎯	Input Filter	20 ms		Input Filter
	ĝ	Environment Type	Standard		Thermal environment model
	j 📦	Sensor type	К		Sensortype
	🎯	Disable channel 01	off		Selectively disabling of not used channels reduces the module cycle time
	🎯	Disable channel 02	off		Selectively disabling of not used channels reduces the module cycle time
	🎯	Disable channel 03	off		Selectively disabling of not used channels reduces the module cycle time
	j 📦	Disable channel 04	on		Selectively disabling of not used channels reduces the module cycle time
	j 📦	Disable channel 05	on		Selectively disabling of not used channels reduces the module cycle time
	····· 👔 📦	Disable channel 06	on		Selectively disabling of not used channels reduces the module cycle time
	🗄 🚰 Simi	uiation		-	

3.2.3.8 I/O 映射

只有将任务中的变量映射到 I/O 模块上的通道,这样程序中变量才能和 I/O 模块转换的物理量——对应起来。

Ch	nann	el Name	Process Variable	Data Type	Task Class	Inverse	Simulate	Source File	Description [1]
	+0	ModuleOk		BOOL					Module status (1 = module present)
	+0	StaleData		BOOL					Data not from latest cycle
	+0	SerialNumber		UDINT					Serial number
	+0	ModuleID		UINT					Module ID
	+0	HardwareVariant		UINT					Hardware variant
	+0	FirmwareVersion		UINT					Firmware version
	+0	DigitalInput01		BOOL					5 VDC, <0.1 us switching delay, differential
	+0	DigitalInput02		BOOL					5 VDC, <0.1 us switching delay, differential
	+0	DigitalInput03		BOOL					5 VDC, <0.1 us switching delay, differential
	+0	DigitalInput04		BOOL					24 VDC, <2 us switching delay, sink
	+0	DigitalInput05		BOOL					24 VDC, <2 us switching delay, sink
	•	DigitalOutput01	::IOvar:doCoolingFan	BOOL	Automatic			\X20CP1584\loMap.iom	5 VDC, differential
	•	DigitalOutput02		BOOL					5 VDC, differential
	•	DigitalOutput03		BOOL					5 VDC, differential

X20DO4332:

Chanr	nel Name	Process Variable	Data Type	Task Class	Inverse	Simulate	Source File	Description [1]
+0	ModuleOk		BOOL					Module status (1 = module preser
-+0	SerialNumber		UDINT					Serial number
+0	ModuleID		UINT					Module ID
+0	HardwareVariant		UINT					Hardware variant
+0	FirmwareVersion		UINT					Firmware version
	DigitalOutput01	::IOvar:doTemp_Zone01	BOOL	Automatic			\X20CP1584\loMap.iom	24 VDC / 2 A, source
۰.	DigitalOutput02	::IOvar:doTemp_Zone02	BOOL	Automatic			\X20CP1584\loMap.iom	24 VDC / 2 A, source
	DigitalOutput03	::IOvar:doTemp_Zone03	BOOL	Automatic			\X20CP1584\loMap.iom	24 VDC / 2 A, source
	DigitalOutput04		BOOL					24 VDC / 2 A, source
+0	StatusDigitalOutput01		BOOL					Status digital output 01 (0 = OK)
+0	StatusDigitalOutput02		BOOL					Status digital output 02 (0 = OK)
+0	StatusDigitalOutput03		BOOL					Status digital output 03 (0 = OK)
+0	StatusDigitalOutput04		BOOL					Status digital output 04 (0 = OK)

X20AT6402 (第一块)

Channel Name	F	Process Variable	Data Type	Task Class	Inverse	Simulate	Source File	Description [1]
+ ModuleO)k		BOOL					Module status (1 = module present)
+ Serial Nur	mber		UDINT					Serial number
+ ModuleIE	0		UINT					Module ID
+ Hardware	eVariant		UINT					Hardware variant
+ Firmware	Version		UINT					Firmware version
+ Temperat	ture01 :	::IOvar:atTemp_Zone01_CH01	INT	Automatic			\X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ Temperat	ture02 :	::IOvar:atTemp_Zone01_CH02	INT	Automatic			\X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ Temperat	ture03 :	::IOvar:atTemp_Zone01_CH03	INT	Automatic			\X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ Temperat	ture04 :	::IOvar:atTemp_Zone02_CH01	INT	Automatic			\X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ Temperat	ture05 :	::IOvar:atTemp_Zone02_CH02	INT	Automatic			\X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ Temperat	ture06	::IOvar:atTemp_Zone02_CH03	INT	Automatic			\X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ StatusInp	out01		USINT					Status of analog inputs 01 to 04
+ StatusInp	out02		USINT					Status of analog inputs 05 to 06
V20AT640	2(꼌-	 -+						
720A1040	2(笻-	人			.			
Channel Name	F	Process Variable	Data Type	Task Class	Inverse	Simulate	Source File	Description [1]
+ ModuleO	k		BOOL					Module status (1 = module present)
+ SerialNur	mber		UDINT					Serial number
+ ModuleIE)		UINT					Module ID
 Hardware 	eVariant		UINT					Hardware variant
+ Firmware	Version		UINT					Firmware version
						_		
+ Temperat	ture01 :	:IOvar:atTemp_Zone03_CH01	INT	Automatic			X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ Temperat	ture02 :	:IOvar:atTemp_Zone03_CH02	INT	Automatic			X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ Temperat	ture03	:IOvar:atTemp_Zone03_CH03	INT	Automatic			X20CP1584\loMap.iom	Thermocouple; Temperature [0.1°C]
+ StatusInp	out01		USINT					Status of analog inputs 01 to 04

3.2.3.9 程序编译及下载

做好以上配置之后,就可以编译并下载。

可以使用工具栏中的 Build(F7)进行编译:

	•						
Cor	ntrol.apj/(CP1584 - A	Automation Studi	o V 4.3.6.	57 SP #	AS Site Lice	ense (Leg
en	Project	Debug	Source Control	Online	Tools	Window	Help
	← →	× 😰 [2 C2 C 📜				U 🥫 🚽
	•	+ × 👂	X20DS1119 [I/O	🔛 Build	1 (F7)		
Ż	8	<i>\</i>		Build	ds the er	ntire config	uration

编译成功的话会在左下角的输出窗口显示编译完成且没有错误:

_				
	#	Category	Date/Time	Description
ľ	1	🚺 Info	12.06.2018 12:48:02,0189	Building project TempControl, configuration CP1584
	2	🚺 Info	12.06.2018 12:48:02,8727	Analyzing project
	3	🚺 Info	12.06.2018 12:48:04,9338	Generating header files
	4	🚺 Info	12.06.2018 12:48:04,9962	Generating archive files
	5	🚺 Info	12.06.2018 12:48:07,6686	Building configuration object "ashwd"
	6	🚺 Info	12.06.2018 12:48:08,2488	Building configuration object "asfw"
	7	🚺 Info	12.06.2018 12:48:08,9986	Building configuration object "sysconf"
	8	🚺 Info	12.06.2018 12:48:09,9813	Building configuration object "arconfig"
	9	🚺 Info	12.06.2018 12:48:10,5751	Building system configuration file "ashwac"
	10	🚺 Info	12.06.2018 12:48:12,7338	Compiling C:/projects/TempControl/Logical/IOvar/Main.st
	11	🕛 Info	12.06.2018 12:48:13,0146	Compiling C:/BrAutomation/AS43/AS/GnuInst/V4.1.2/i386-elf/include/bur/_bur_pvdef.st
	12	🚺 Info	12.06.2018 12:48:13,2483	Linking C:/projects/TempControl/Temp/Objects/CP1584/X20CP1584/IOvar/a.out
	13	🕛 Info	12.06.2018 12:48:14,5837	Building program "IOvar" as "IOvar"
	14	🕛 Info	12.06.2018 12:48:14,8957	Building configuration object "iomap"
	15	🕛 Info	12.06.2018 12:48:15,0985	Building system configuration file "Role"
	16	🕛 Info	12.06.2018 12:48:15,2700	Building system configuration file "User"
	17	🕛 Info	12.06.2018 12:48:15,4416	Building file C:/projects/TempControl/Temp/Objects/CP1584/X20CP1584/TCData/TCData.imx
	18	🕛 Info	12.06.2018 12:48:20,7824	Generating binary module C:/projects/TempControl/Temp/Objects/CP1584/X20CP1584/TCData.br
	19	🕛 Info	12.06.2018 12:48:23,7336	Build: 0 error(s), 0 warning(s)

3.2.3.9.1 使用 Offline Installation

CPU 的应用程序及操作系统的储存介质 CF Card 如果是全新空白的没有经过处理,是无法用它启动 CPU 来进行在线编程与调试的工作。所以推荐在第一次使用时,利用 Automation Studio 的 Offline Installation 功能进行离线下载:

ontrol\1	ontrol\TempControl.apj/CP1584 - Automation Studio V 4.3.6.57 SP # AS Site License (Legacy)													
Insert	Open	Pro	ject	Debug	Source Co	ntrol Online	e To	ols	Wind	dow He	lp			
1.6	h fhi i		Buil	d Configu	uration	F7		l e	E III.	Ф Ф	🖪 🚽 🕷	*.	i 🕜 🗆	
			Reb	uild Confi	iguration	ion Ctrl+F7		c						
6) 📖 🧳		Clea	n Config	uration	[
	S () ()		Buil	d Cross R	eference		ss Va	ariable	e	Data Type	Task Class	Inverse	Simulate	Source File
34		e¥.	Stop	Build		Ctrl+Pause				BOOL			Cincipato	
I			Bato	:h		ļ	·			BOOL				
X20BB8	30		Proj	ect Install	ation)	P.	Tra	nsfer T	o Target			(Ctrl+F5
🦺 X2	0BC0083		Expo	Export to Runtime Utility Center				Off	fline in	stallation				Alt+F8
1 X2	0PS9400 ×							Ger	nerate	Project In	stallation P	ackage	Sł	nift+F8
1	x20DS		Upd	ate Librar	y Declaratio	ons	Transfer Automation Runtime							
- 1	X20DO		Cha	nge Runti	ime Version	s				BOOL				
	X20AT		Analyze Network						BOOL					
	AZUAT		Com	Compare Local Source Files						BOOL				
						-			BOOL					
			Sett	ings			<u> </u>		-	BOOL	A:			Waaaata

Offline installation 位于 Project->Project Installation 菜单下,使用 Offline installation 首先会自动运行编译(Build)

编译完成后,会弹出将当前项目离线装载到 CF Card 中的提示。此时需要将 CF Card 插入 CF Card 适配器,并连接至计算机。此时 Offline Installation 的对话框中就能找到这张 CF card :

Coffline Installation	to the Meeting	×							
Project	Target								
Configuration ID: TempControl_Cl AR Version: E4.34 Configuration Version: 1.0.0	Configuration ID AR Version: - Configuration Ve	ersion: -							
Local removable storage on drive H: (977 MiB) Path in local file system Local removable storage on drive H: (977 MiB)									
There is no additional information available at the mome	nt.								
Progress									
		Cancel							
	Install on application storage	Close							

此时会提示 Offline Installation 这个操作会导致 CF Card 上所有内容丢失,选择确定即可开始烧卡:

Target app	lication storage will be deleted
	Attention! This operation will partition and format the selected target. All data on the target, including the user partition and non volatile memory will be lost. Do not restart the selected target until the installation is completed! Do you want to proceed?
	Yes No

整个烧卡过程只需数秒就可以完成(绿色进度条到底即表示完成):

🍓 Offline Installation	THE AT A MENT	and therein		×
Project		Target		
Configur AR Vers Configur	ration ID: TempControl_C ion: E4.34 ration Version: 1.0.0		Configuration ID: AR Version: - Configuration Version:	
CLocal removable st	orage on drive H: (977 MiB) 🔹	4 ₃		0
Local removable application	on storage prepared.			T
Progress				Cancel
		Selec	t new transfer target	Close

此时可以在 Windows 中移除 CF Card 适配器并将 CF Card 拔出并查到 CPU 上运行。

3.2.3.9.2 使用在线下载

一旦进行过 Offline Installation , CF Card 中已经有可执行的 AR 操作系统且 CPU 已经可以上电运行之

后,程序的修改后的编译下载使用在线下载的方式比较方便和快捷。

使用 Online 菜单下的 Settings



在出现的 Online Settings 窗口中激活 Browse,就能在右侧打开浏览窗口,在当前可用连接的列表中选择 对象并使用拖曳的方式放置到左侧的连接中。

Online Settings*	Ų Online Settings* ×											
🔈 🅾 🍰 🚸 🛷	🎍 🅾 🍰 🤣 🚳 🛃 🚟 😽											
Ethemet Serial Mo	Rowse @			1								
Connection name	Browses f network a	ior targets in area	the current	۱ er	Destination IP address	*	Target type description	INA no	IP Address	Subnet Mask	Host name	
ARsim_TCPIP			1	· · ·	127.0.0.1		X20CP1585	16	10.86.12.133	255.255.255.0	br-automat	
👍 ARwin			1		192.168.0.2		X20CP1585	8	10.86.12.209	255.255.255.0	br-automat	
👍 TCPIP			1				X20CP1585	49	10.86.12.165	255.255.255.0	br-automat	
👍 X20CP1586			1		10.86.12.136		X20CP1585	3	10.86.12.223	255.255.0.0	br-automat	
👍 X20CP1585			1		10.86.12.102		X20CP1585	38	10.86.12.154	255.255.255.0	br automat	
👍 X20CP1584 🧹			1		10.86.12.205		🛷 X20CP1584	1	10.86.12.205	255.255.255.0	br-autom at	
							L					

右键点击新增添的连接并点击 Connect,即可发起与该 CPU 控制器的连接。

Ethernet	Serial	Modem	Remote					
Connectio name	n			Use in active co	Source INA node number	Destination IP address	*	Target type description
👍 ARsi	im_TCPIP				1	127.0.0.1		X20CP1585
👍 ARw	vin				1	192.168.0.2		X20CP1585
👍 TCP	IP				1			X20CP1585
👍 X20	CP1586				1	10.86.12.136		X20CP1585
👍 X20	CP1585				1	10.86.12.102		X20CP1585
<u>→</u> X20)CP 1584			onnect isconnect dd TCPIP Conn dd ARsim Conn dd ARwin Conn	ection lection	10.86.12.205		X20CP1584

可以查看左下角的状态栏,如果有类似下图中 Run 字样则表示在线连接成功:

				•	*			
• 4	×	Prope	rties - X20AT6402a					★ û ×
		4	9					
	Ť.	Channe	el Name	Proce	ess Variable	Data Type	Description [1]	
urstion		+0	+ ModuleOk			BOOL	Module status (1 = m	odule present)
uration	- II							
r		+0	SerialNumber			UDINT	Serial number	
		+0	ModuleID			LINT	Module ID	.
Re		- 🕺 I	/O Mapping 월 Config	uration				
			ANSL: tcpip/DAIP=10.86	.12.223 /F	REPO=11159 /ANSL=1	/PT=11169 X20CP1585	D4.34 \Lambda RUN	L H

在连接的情况下即可以进行在线的监控、调试和程序下载。

3.3 关闭设备

3.3.1 关闭设备前的准备

本模型为温度控制模型,加热装置即便在断电后也有可能残存较高的温度,容易对不明情况的人员造成伤害,所以在关闭电源之前,确保应用程序已经停止各个温区进行加热的动作,且模型各个温区的温度至少低于 50℃且处于温度下降的过程后再关闭电源。

3.3.2 关闭电源

只需要断开 PLC 控制部分和温度控制部分的 220VAC 电源线的供电连接,即可对整套系统进行电源关闭操作。

4 PLC 控制器部分

PLC 控制器部分最主要的部件是 PLC CPU 模块。所有的编程工作,包括对温度控制模型的控制算法实现及输入输出模块的控制均在 PLC CPU 中实现和完成。

4.1 硬件组成



4.1.1 底座支架及背板

底座采用 2020 标准铝型材组合而成,固定 CPU 的背板采用 304 不锈钢制作。

4.1.2 24VDC 电源

4.1.2.1 品牌及型号

CPU 供电电源采用 Meanwell 明纬超薄导轨电源 HDR-15-24

4.1.2.2 技术参数

输出额定电压:24VDC 输出额定电流:0.63A 输出额定功率:15W 输入电压:220VAC @50Hz 输入电流:0.25A

HDR-15-24 详细参数可以见 Meanwell 网站: http://www.meanwell.com/webapp/product/search.aspx?prod=HDR-15

4.1.2.3 接线



4.1.3 PLC 控制器及配件

4.1.3.1 X20CP1584

4.1.3.1.1 技术参数

主要技术指标: X20 CPU,

ATOM 0.6 GHz, 256 MB DDR2 RAM, 1 MB SRAM, Removable program memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB ports, 1 RS232 interface, 1 Ethernet port 10/100/1000 Base-T, 1 POWERLINK interface,

详细参数可参考如下链接:

https://www.br-automation.com/en/products/control-systems/x20-system/x20-cpus/x20cp1584/



4.1.3.1.2 主要部件及接口描述

4.1.3.1.3 LED 状态指示灯描述

CPU LED 状态指示灯

Figure	LED	Color	Status	Description
			On	Application running

	D /F	C	Dia bia a	De et me de motence et als
	K/E	Green	вшкіпд	Boot mode system start:
				CPU initializing the application, all bus systems and I/O modules ¹
R/E			Double flash	BOOT mode (during firmware update) ¹⁾
RDY/F		Red	On	SERVICE mode
PLK			Blinking	The "R/E" LED blinks red and the "RDY/F" LED blinks yellow when there is
ETH				a license violation.
CF	RDY/F	Yellow	On	SERVICE or BOOT mode
			Blinking	The "RDY/F" LED blinks yellow and the "R/E" LED blinks red when there is
				a license violation.
-	S/E	Green/Red		Status/Error LED. The statuses of this LED are described in section "LED
				"S/ E"" on page 10.
	PLK Gr	Green	On	A link to the POWERLINK peer station has been established.
			Blinking	A link to the POWERLINK peer station has been established. The LED
				blinks when Ethernet activity is taking place on the bus.
	ETH	Green	On	A link to the peer station has been established.
			Blinking	A link to the peer station has been established. Indicates Ethernet activity
				is taking place on the bus.
	CF	Green	On	CompactFlash inserted and detected
		Yellow	On	CompactFlash read/write access
	DC	Yellow	On	CPU power supply OK
		Red	On	Backup battery empty

CPU 集成电源 LED 状态指示灯

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
The second			Blinking	PREOPERATIONAL mode
1			On	RUN mode
	e	Red	Off	No power to module or everything OK
• 1			Double flash	LED indicates one of the following states:
				The X2X Link supply for the power supply is overloaded
				I/O supply too low
The Party Name				Input voltage for X2X Link supply too low
	e + r	Red on / Gree	en single flash	Invalid firmware
	S	Yellow	Off	No RS232 activity
			On	The LED lights up when data is being sent or received via the RS232 interface.
	I	Red	Off	The X2X Link supply is within the valid limits
			On	The X2X Link supply for the power supply is overloaded

4.1.3.1.4 接线端子定义



4.2 使用与接线

4.2.1 220VAC 供电插头



PLC 控制部分的 220VAC 交流电源插头需与民用三孔插座连接使用。该电源线给 CPU 供电的 24VDC 电源 模块(见 3.3.2)提供输入电源。连接电源线后系统即得电工作,要关闭时需断开外部电源(如带有开关的插 座),或者直接拔下电源线插头断开电源。

4.2.2 运行模式拨码

需要将运行模式拨码拨到 RUN 模式 CPU 才能正常运行;



其他两种运行模式请参考 CPU 的用户手册。

4.2.3 以太网接口



X20 CPU 上的以太网 IF2 接口主要用于安装有 Automation Studio 的计算机与控制器之间通讯连接、下载编程调试。可以使用系统配套的以太网电缆与计算机连接。具体连接的方式、Automation Studio 中必要的操作和配置,请参考 TM210 中控制器对象连接与项目安装的部分。

4.2.4 POWERLINK 接口

X20 CPU 上的 POWERLINK IF3 接口主要用于与 POWERLINK 从站设备通讯连接。本例中 PLC CPU 控制器上的 IF3 接口与温度控制部分的 PLC I/O 模块上的总线控制模块 X20BC0083 相连,即可以使 CPU 可以控制该 POWERLINK 从站点的 I/O 模块。

5 温度控制部分

5.1 硬件组成



5.1.1 底座支架及背板

底座采用 2020 标准铝型材组合而成,固定 CPU 的背板采用 304 不锈钢制作。

5.1.2 24VDC 电源

5.1.2.1 品牌及型号

CPU 供电电源采用 Meanwell 明纬超薄导轨电源 HDR-100-24

5.1.2.2 技术参数

输出额定电压:24VDC 输出额定电流:3.83A 输出额定功率:92W 输入电压:220VAC @50Hz 输入电流:0.25A HDR-15-24 详细参数可以见 Meanwell 网站:

http://www.meanwell.com/webapp/product/search.aspx?prod=HDR-100

5.1.2.3 接线

5.1.3 PLC I/O

5.1.3.1 简介

5.1.3.2 X20BC0083

5.1.3.2.1 功能

X20BC0083 是 POWERLINK 总线控制器,它可以连接 X20 系列 I/O 模块并接入到 POWERLINK 网络中。X20BC0083 需配合 X20PS9400 电源模块和 X20BB80 底座模块一起使用。

5.1.3.2.2 技术参数

https://www.br-automation.com/en/products/control-systems/x20-system/bus-controllers/x20bc0083/

Figure	LED	Color	Status	Description
	S/E ¹⁾	Green	Off	No power supply or mode NOT_ACTIVE.
				The controlled node (CN) is either not getting power, or it is in the NOT_AC-
				TIVE state. The CN waits in this state for about 5 seconds after a restart.
				Communi- cation is not possible with the CN. If no POWERLINK commu-
				nication is detect- ed during these 5 seconds, the CN switches to the
S/E				BASIC_ETHERNET state (flickering).
				If POWERLINK communication is detected before this time expires, how-
BC				ever,
X20				the CN switches immediately to the PRE_OPERATIONAL_1 state.
31415 V16			Flickering	BASIC_ETHERNET mode.
				The CN has not detected any POWERLINK communication. It is possible to
				com- municate directly with the CN in this state (e.g. with UDP, IP, etc.).
				If POWERLINK communication is detected while in this state, the CN
				switches
				to the PRE_OPERATIONAL_1 state.
			Single flash	PRE_OPERATIONAL_1 mode.
				When operated on a POWERLINK V1 manager, the CN immediately
				switches to the PRE_OPERATIONAL_2 state.
				When operated on a POWERLINK V2 manager, the CN waits until an SoC
				frame

5.1.3.2.3 LED 状态指示灯

			is received and then switches to the PRE_OPERATIONAL_2 state.
		Double flash	PRE_OPERATIONAL_2 mode.
			The CN is normally configured by the manager in this state. Issuing a com
			mand (POWERLINK V2) or setting the data valid flag in the output dat
			(POWERLINK V1) then switches to the READY_TO_OPERATE state.
		Triple flash	READY_TO_OPERATE mode.
			In a POWERLINK V1 network, the CN automatically switches to the OPE
			ATIONAL state as soon as input data is present.
			In a POWERLINK V2 network, the manager switches to the OPERATION
			state by issuing a command.
		On	OPERATIONAL mode.
			PDO mapping is active and cyclic data is being evaluated.
		Blinking	STOPPED mode.
			No output data is produced or input data supplied. It is only possible to
			switch to or leave this state after the manager has given the appropriate
			command.
	Red	On	The controlled node (CN) is in an error state (failed Ethernet frames, in-
			creased number of collisions on the network, etc.).
			If an error occurs in the following states, then the green LED blinks over
			the red LED:
			PRE_OPERATIONAL_1
			PRE_OPERATIONAL_2
			READY_TO_OPERATE
			Statue
			Green
			t
			Error
			Red
			t
			LED "S/E"
			t
			Note:
			The LED blinks red several times immediately after startup. This
			not an error, however.
			• The LED is lit red for CNs with configured physical node number 0
			but that have not yet been assigned a node number via dynamic
			node allocation
			(DNA).
L/A IF	Green	On	Link established to the remote station
_,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		Blinkina	A link to the remote station has been established and there is activity or
		5	bus.

5.1.3.2.4 POWERLINK 节点拨码

POWERLINK 允许网络中最多有 239 个从节点, X20BC0083 模块上的两个 16 位拨码可设置其作为

POWERLINK 从站点的节点编号。

Switch posi-	Description
tion	
0x00	Only permitted when operating the POWERLINK node in DNA mode.
0x01 - 0xEF	Node number of the POWERLINK node Operation as a controlled node.
0xF0 - 0xFF	Reserved, switch position not permitted

5.1.3.3 X20BB80

5.1.3.3.1 功能

X20BB80 是 X20BC0083 这类总线控制模块的底座模块,为总线控制器模块及其配套的电源模块提供安装 位置,并且能和 X20 电气模块 X20BMxx 相连,以便 后续的 X20 I/O 模块。

5.1.3.3.2 技术参数

https://www.br-automation.com/en/products/control-systems/x20-system/system-modules-forbus-controllers/x20bb80/

5.1.3.4 X20PS9400

5.1.3.4.1 功能

X20PS9400为总线控制模块及其后连接的 X20 I/O 模块提供电源供应。

5.1.3.4.2 技术参数

https://www.br-automation.com/en/products/control-systems/x20-system/system-modules-forbus-controllers/x20ps9400/

5.1.3.4.3 LED 状态指示灯

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	е	Red	Off	No power to module or everything OK
8			Double flash	LED indicates one of the following states:
0 PS 940				The bus controller / X2X Link supply for the power supply is over- loaded
X2(I/O supply too low
The second se				Input voltage for bus controller / X2X Link supply too low
	e + r	Red on / Gree	en single flash	Invalid firmware
	I	Red	Off	The bus controller / X2X Link supply is within the valid limits
			On	The bus controller / X2X Link supply for the power supply is overloaded
	S	Yellow	Off	No data traffic via service interface
			On	Data is being transmitted via the service interface

5.1.3.4.4 端子定义

5.1.3.4.5 接线

5.1.3.5 X20DS1119

5.1.3.5.1 功能

X20DS1119 是个多功能模块,在本模型中它控制温度控制模型中的风扇模块的起停。

5.1.3.5.2 技术参数

https://www.br-automation.com/en/products/io-systems/x20-system/digital-outputs/x20ds1119/

5.1.3.5.3 LED 状态指示灯

Figure	LED	Color	Status	Description	
	r	Green	Off	No power to module	
					RESET mode
1000			Double flash	BOOT mode (during firmware update) ¹⁾	
R. C.			Blinking	PREOPERATIONAL mode	
			On	RUN mode	
£ 1 5	е	Red	Off	No power to module or everything OK	
S 3 E			Single flash	I/O error. Possible causes:	
0 4 5				• SSI error ²⁾	
×			Double flash	System error. Possible causes:	
				• Motion function error ³⁾	
				• I/O oversampling error ⁴⁾	
				• Edge detection error ⁴⁾	
			Triple flash	I/O error and system error occur together	
			On	Error or reset status	
	1 - 8	Green		Status of the corresponding digital signal	

5.1.3.5.4 端子定义

5.1.3.5.5 接线

本模型中的 X20DS1119 使用了其一号通道 (Channel 1) 作为冷却风扇启停的输出控制通道。风扇的正 极接入 Channel 1, 负极接入了 GND。 (实际接线照片)

5.1.3.5.6 Automation Studio I/O 配置

需将 X20DS1119 模块的 Channel 1 配置成输出才能让应用程序控制风扇的启停。

(AS 中截图)

12 X20DS1119 [Configuration] ×					
🔠 🔍 🔶 🖗 🎝 🛣					
Name	Value	Unit	Description		
🖃 🙀 X20DS1119					
E Function model	default		Module operating mode		
🖃 🔤 General					
Module supervised	on		Service mode if there is no hardware module		
🖗 Supply information	off		Additional information of power supplies		
🖗 SDC information	off	off Additional SDC inform;			
····· 🖗 Network information	off		Additional network information		
SI-frame generation	X2X cycle optimized		Cycle for generating SI-frame		
🚊 🚰 System timer					
🖗 Cycle time	100		Cycle time in us (25255us)		
🖗 Cycle prescaler	2		Multiples of system timer		
🖗 Cycle offset	0		Cycle offset in us (-40964095us)		
🗄 🛶 🚰 Physical I/O channel configuration					
🛶 🖗 Configuration channel 01	output push/pull		Select operating mode input/output channel		
🖗 Output control channel 01	direct I/O handling		Select control source		
····· 🖗 Configuration channel 02	input		Select operating mode input/output channel		
····· 🖗 Output control channel 02	direct I/O handling		Select control source		
🖗 Configuration channel 03	input		Select operating mode input/output channel		
🖗 Output control channel 03	direct I/O handling		Select control source		
🖗 Configuration channel 04	input		Select operating mode input channel		
🧼 🖗 Configuration channel 05	input		Select operating mode input channel		
🛱 🖓 🖓 🖓 🖓 🖓					
🖻 🔤 🚰 Direct I/O					
🖻 🖳 🚰 Direct I/O handling	on		De-/activate direct I/O handling		
🖗 Read input status	on		Select if input channels are used		
🖗 Output update cycle	X2X cycle optimized		Cycle for output update		
Oirect control of output channel 01	default		Select operating mode of output		
🖗 Direct control of output channel 02	default		Select operating mode of output		
Direct control of output channel 03	default		Select operating mode of output		
🖻 ···· 🚰 Oversampled I/O					
主 \cdots 🚰 Oversampled I/O handling	off		De-/activate oversampled I/O handling		
Edge detection					
主 🚵 Edge detection	off		De-/activate edge detection		
🖻 ···· 🚰 Movement					
主 ···· 🚰 Movement	off		De-/activate movement		
🚊 🚰 SSI encoder					
🗄 🖮 🚰 Encoder	off		De-/activate SSI		
E 🚰 Counter					
😟 🔤 Counter mode	off		Select counter mode		
🗄 🗄 🛗 Simulation					

5.1.3.6 X20DO4332

5.1.3.6.1 功能

X20DO4332 是 4 通道数字量输出模块,单个通道输出电流为 2A。在本模型中用于控制加热管的通断。 注意:

数字量输出的开关频率是有限制的,对于加热管这类纯电阻性质的负载,X20DO4332最大的开关频率为500Hz。

警告!

严禁使用 Automation Studio 的强制输出功能将 DO 模块输出强制输出。在应用程序的控制算法中,也要 注意不可长时间将 DO 模块设置为输出状态。加热管长时间输出会导致温度过高,造成潜在的危险甚至设 备的损坏!

5.1.3.6.2 技术参数

https://www.br-automation.com/en/products/io-systems/x20-system/digital-outputs/x20do4332/

5.1.3.6.3 LED 状态指示灯

Figure	LED	Color	Status	Description
	r	Green	Off	Module supply not connected
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
8 1 2			Flickering	Module is in OSP state
4 3 4			(ap- prox. 10	
8 5			Hz)	
50	е	Red	Off	Module supply not connected or everything OK
×			Single flash	Warning/Error on an I/O channel. Level monitoring for digital outputs
				has been triggered.
	e + r	Red on / Gree	n single flash	Invalid firmware
	1 - 4 Orange			Output status of the corresponding digital output

5.1.3.6.4 端子定义

5.1.3.6.5 接线

5.1.3.6.6 Automation Studio 配置

X20DO4332 [Configuration] ×								
Name	Value	Unit Description						
🖃 😭 X20DO4332								
🗄 🖷 🚰 Function model	default	Module operating mode						
🚊 🔤 🚰 General								
····· 📦 Module supervised	on	Service mode if there is no hardware module						
····· 🖗 Output status information	on	Additional output status information						
Packed outputs	off	Packed I/O data instead of single digital outputs						
🗄 🚰 Simulation								

X20AT6402

5.1.3.6.7 功能

5.1.3.6.8 技术参数

https://www.br-automation.com/en/products/control-systems/x20-system/temperature-measurement/x20at6402/

5.1.3.6.9 LED 状态指示灯

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
N			On	RUN mode
079 <u>3</u> 4	е	Red	Off	No power to module or everything OK
F 2 6			On	Error or reset status
50			Single flash	Warning/Error on an I/O channel. Overflow or underflow of the analog
				inputs.
	e + r	Red on / Gree	n single flash	Invalid firmware
	1 - 6	Green	Off	The input is switched off
	Overflow, underflow or open line			
			On	Analog/digital converter running, value OK

5.1.3.6.10 端子定义

5.1.3.6.11 接线

本模型中,一共有三组加热型材,每组型材各有三个热电偶检测型材不同位置的温度(见 4.2.3.3 节)。自 左向右,自下而上,温区分别被命名为 1-1,1-2,1-3,2-1, 2-2,2-3,3-1,3-2,3-3。由于一块 X20AT6402 只能支持 6 个通道的热电偶,所以总共需要两块 X20AT6402 来连接并检测这九个温区的热电 偶。

5.1.3.6.12 Automation Studio I/O 配置

在 IO Configuration 中,需要将 X20AT6402 的热电偶类型配置为 K 型热电偶。另外由于第二个模块只用 到了 1-3 三个通道,故要将 4-6 通道 Disable,否则模块的状态指示灯会显示通道未连接的故障。 第一块 X20AT6402:

Name					Value	Unit	Description
😫 و 🗆	X20A	T640	2				
🖃 📲 Function model			internal compensa		Module operating mode		
		<u>-</u>	Gen	neral			
			٢	Module supervised	on		Service mode if there is no hardware module
			٢	IO cycle counter	off		IO cycle counter
			٢	Input Filter	20 ms		Input Filter
			٢	Environment Type	Standard		Thermal environment model
			١	Sensor type	K		Sensor type
	_		<u>ن</u>	Sensor type Disable channel 01	K off		Sensor type Selectively disabling of not used channels reduces the module cycle time
			9 9 9	Sensor type Disable channel 01 Disable channel 02	K off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
			9 9 9	Sensor type Disable channel 01 Disable channel 02 Disable channel 03	K off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
			9 9 9 9	Sensor type Disable channel 01 Disable channel 02 Disable channel 03 Disable channel 04	K off off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
			9 9 9 9 9	Sensor type Disable channel 01 Disable channel 02 Disable channel 03 Disable channel 04 Disable channel 05	K off off off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time
			9 9 9 9 9 9	Sensor type Disable channel 01 Disable channel 02 Disable channel 03 Disable channel 04 Disable channel 05 Disable channel 06	K off off off off off off		Sensor type Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time Selectively disabling of not used channels reduces the module cycle time

第二块 X20AT6402:

N			Mahar	11-2	Description
ivame			value	Unit	Description
🗆 📲 X20AT6402a					
🖃 🛶 🚰 Function model			internal compensa		Module operating mode
ė… į	🚰 Ger	neral			
	🌍	Module supervised	on		Service mode if there is no hardware module
	🌍	IO cycle counter	off		IO cycle counter
	🎯	Input Filter	20 ms		Input Filter
	🌍	Environment Type	Standard		Thermal environment model
	<u>1</u> 📦	Sensor type	К		Sensortype
	🌍	Disable channel 01	off		Selectively disabling of not used channels reduces the module cycle time
	🌍	Disable channel 02	off		Selectively disabling of not used channels reduces the module cycle time
	🌍	Disable channel 03	off		Selectively disabling of not used channels reduces the module cycle time
	📦	Disable channel 04	on		Selectively disabling of not used channels reduces the module cycle time
	📦	Disable channel 05	on		Selectively disabling of not used channels reduces the module cycle time
	<u>,</u> 📦	Disable channel 06	on		Selectively disabling of not used channels reduces the module cycle time
÷	🚔 Sim	uiation			

5.1.3.7 X20BM11

5.1.3.7.1 功能

X20BM11 是 X20 I/O 模块的底座,用于安装 X20 IO 模块,多个 X20BM11 左右连接后,可以组成 X20 IO 模块组,通过 X2X Link 与 X20 总线控制模块通讯。同时 X20BM11 模块也为 X20 IO 模块供电(总线和 IO 部分)。

5.1.3.7.2 技术参数

https://www.br-automation.com/en/products/control-systems/x20-system/bus-modules/x20bm11/

5.1.3.8 X20TB12

X20TB12 为 X20 模块的端子,提供外部接线的可能。

5.1.4 温度控制组件

5.1.4.1 被加热铝型材

5.1.4.1.1 材料

5.1.4.1.2 尺寸

5.1.4.2 加热管

5.1.4.2.1 尺寸

直径:3.8mm 长度:16mm

5.1.4.2.2 电气参数

额定电压:24VDC 额定功率:30W

5.1.4.2.3 安装位置

加热棒安装于被加热对象的正下方,深入距离为16mm,即与加热管长度相当

5.1.4.2.4 接线

见 5.1.3.6.5

5.1.4.3 热电偶

(淘宝原图贴图即可)

热电偶为温度检测传感器的一种,其利用双金属冷端与热端之间会产生电势差的原理检测被测物体的温度。

5.1.4.3.1 规格类型

本模型的热电偶模块为 K 型热电偶。线长 500mm,直接接入 X20AT6402 模块。

5.1.4.3.2 安装位置

每个加热对象(铝型材)上拥有3个热电偶,分布在上中下三个位置。

5.1.4.3.3 接线

见 5.1.3.7.5

5.1.4.4 散热风扇

5.1.4.4.1 品牌型号

SEPA MFB25B05

5.1.4.4.2 技术参数

<u>http://www.sepa-europe.com/en/fan/axial/mfb25b05</u> 手册下载: http://www.sepa-europe.com/sites/sepa-europe.com/content/pdfs/en/mfb25bxx.pdf

5.1.4.4.3 尺寸

见手册

5.1.4.5 耦合板

5.1.4.5.1 材料

耦合板也采用 304 不锈钢制作,厚度为 3mm。

5.1.4.6 保护盖

5.1.4.6.1 材料

保护盖使用透明丙烯酸塑料制成,用户防护意外触碰到加热元件而造成的烫伤事故。

注意!由于散热的需要,除了正面之外,周边没有保护,所以仍然有烫伤风险!

5.2 供电与接线

5.2.1 220VAC 供电插头

5.2.2 PLC 控制器的通讯连接

5.2.3 PLC 控制器与温度控制器之间的连线

6 物料清单

6.1 PLC 控制器部分

(表格 PLC 部分清单)

6.2 温度控制部分

(表格 温度控制部分)