ECR60X2

TwinCAT 快速启动指南



深圳锐特机电技术有限公司

第一章 TwinCAT3.0 安装

1.1 安装条件

操作系统: windows 7 以上, TwinCAT3.0 可以兼容 windows10 操作系统

CPU: 英特尔 CPU

网卡: intel 网卡, 其他厂家网卡可以演示用, 同步控制精度很差

软件版本: <u>TwinCAT V3.1.4022.29</u>

About TwinCAT System

TwinCAT System Service v3.1.0.2306

TwinCAT v3.1.4022.29

1.2 软件安装

正常安装完成以后, 右下角有 TwinCAT 后台



OK

第二章 TwinCAT3.0 设置

2.1 添加设备描述文件

按照图示将 RTELLIGENT TwoAxisStepper.xml 文件拷贝至 TwinCAT 相关路径

	名称	修改日期	类型	大小
122	RTELLIGENT TwoAxisStepper	2021/11/27 13:39	XML 源文件	228 KB

2.2 新建项目及设置

2.2.1 新建项目,如下图:

			0		DEURNULL
New Project			?	×	Open
▶ Recent	Sort by: Default 🔹 🏢 🔝		Search (Ctrl+E)	ρ.	
 Installed TwinCAT Measurement TwinCAT Projects TwinCAT PLC TcXaeShell Solution 	TwinCAT XAE Project (XML format)	TwinCAT Projects	Type: TwinCAT Projects TwinCAT XAE System Manage Configuration		Open Project/ Solution New project New TwinCAT Project Search project templates TwinCAT XAE Project (XML format) TwinCAT Projects TwinCAT Mae Project TwinCAT Measurement More project templates
Not finding what you are looking for Open Visual Studio Installer Name: Location: Solution name: ECR60X2Demo	? bace\ECR60X2Demo\	•	Browse ✓ Create girectory for solution Add to Soyrce Control	s	- Search Error List

建立一个 ECR60X2Demo 的项目。

Solution Explorer	• ₽×
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Search Solution Explorer (Ctrl+;)	ρ-
 Solution 'ECR60X2Demo' (1 project) ECR60X2Demo SYSTEM MOTION PLC SAFETY C++ ANALYTICS I/O 	
Te Devices	
The second secon	

2.2.2 添加主站网卡:

在 I/O > Devices 目录下,右键 "Add New Item",如下图所示



然后添加类型为 EtherCAT > EtherCAT Master,如下图:

ype:	EtherCAT EtherCAT Master EtherCAT Slave EtherCAT Automation Protocol (Network Variables) EtherCAT Automation Protocol via EL6601, EtherCAT EtherCAT Simulation EtherCAT Simulation	^	Ok Cancel
	Profibus DP Profinet CANopen DeviceNet EtherNet/IP EtherNet/IP SERCOS interface Public USB BACnet Bachoff Hardware	~	Target Type O PC only O CX only O BX only O All

点击 "OK" 以后, 需要选择使用的网卡:

Device Found At	~
(none) 蓝牙网络连接 (Bluetooth Device (Personal Area Network)) WLAN (Qualcomm Atheros AR956x Wireless Network Adapter) 本地连接*1 (Microsoft Wi-Fi Direct Virtual Adapter #2) <mark>以太网 (Realtek PCIe GBE Family Controller)</mark> 本地连接*2 (Microsoft Wi-Fi Direct Virtual Adapter)	OK Cancel O Unused All
	Help

此处,可能一些电脑不能显示正确的网卡,可以先直接选择 "none"。设置完成后,如下图所示:



2.2.2 安装网卡驱动

ECR60V200Test - Microsoft Visual Studio		V Quick Launch (Ctrl+Q)
HLE EDIT VIEW PROJECT BUILD DEBU	G TWINCAT TWINSARE PLC TOOLS SCOPE WINDOW HELP フ・マ・ト Attach・ - Release TwinCAT RT (x64) ・ 声 ・ デ ・ 日 ト = 日 4-6 4 4 日 0 白 田 田 つ	- □ / □ ☆ ◎ □ · C - ◎ □ □ □
Solution Explorer 🔹 👎 🗙	ECR60V200Test 😕 🗙	•
Search Solution Explorer (Ctrl+;) Search Solution Explorer (Ctrl+;) Solution 'ECR80V200Test' (1 project) Solution 'ECR80V200Test' (1 project) Solution 'ECR80V200Test' (1 project) SAFETY SAFETY C + Devices SAFETY Devices Mappings	General Adapter EtherCAT Online COE - Online Installation o ONEtwork Adapter OOS (NDIS) PCI DPRAM Description: 以太河 (Realtek PCIe GBE Family Controller) Installation o Device Name: \DEVICE\(DSDDBB2x BCCA-4587-AE31-1AC57FBEEC4A) Installation o PCI Bus/Slot: Search Search MAC Address: 4c ed fb 0f b6 10 Compatible Devices IP Address: 00.00 (0.00.0) Installation o IP romiscuous Mode (use with Wireshark only) Uritual Device Names E###	f TwinCAT RT-Ethernet Adapters f TwinCAT RT-Ethernet Adapters plers plers update List Update List
	O Adapter Reference	

通常安装完驱动以后,再点击"Search"按钮,就可以找到网卡了,如下图所示:

ECR60V200Test - Microsoft Visual Studio	
FILE EDIT VIEW PROJECT BUILD DEB	UG TWINCAT TWINSAFE PLC TOOLS SCOPE WINDOW HELP
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Solution Explorer 🗾 👻 🕂 🗙	ECR60V200Test +> ×
000 (A) 10 - (D) (A) 00	General Adapter EtherCAT Online CoE-Online
Search Solution Explorer (Ctrl+;)	deneral rouper enercy offinite coe-offinite
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ECR60V200Test	● OS (NDIS) O PCI O DPRAM
SYSTEM MOTION	Description: 以太网 (Realter PCIe GBE Family Controller)
III PLC	
SAFETY	Device Maille. UDEvice (UDDDDbb222-BCCARDSOLARSOLARSOLARSOLARSOLARSOLARSOLARSOLAR
	PCI Bus/Slot: Search
Devices	MAC Address: 4c ed fb 0f b6 10 Compatible Devices
Device 1 (EtherCAT)	IP Address: 0.0.0.0.000
Mappings	
	Device Found At
	蓝牙网络连接 (Bluetooth Device (Personal Area Network)) WLAN (Qualcomm Atheros ARe55ix Wireless Network Adapter) Oancel
	O Adap <u>+ thist first I Microsoft MFF Divers Mittel Adaptor 42</u> Cancer West V Constant Control For Divers Mittel Adaptor 42 Cancer
	Number 4 4-30 12 2 (Microsoft WHPT Direct Vinter Adapter) OUnused
	OAII
	Help
	1

2.3 查找驱动器

将驱动器连接好电源,电机与网线。然后在 Device 1 条目中右键,选择"Scan",如下图:



正常情况下,软件提示发现 ECR60X2,并提示是否增加一个对应的运动轴 (NC),如下图所示:



点击 "OK"

此时软件自动添加了两个轴, "Motion > Axes > Axis 1 和 Axis 2"并关联到驱动器 "Drive

1(ECR60X2)"

,项目变成如下所示:

Solution Explorer	→ Ț 🗙 <mark>ECR60X2Demo 🕫 ×</mark>	
◎ ◎ ☆ ☆ -] '◎ - ☞ ≯ -	General Settings Parameter Dynamics Online Functions Coupling Compensation	
Search Solution Explorer (Ctrl+;)		
Solution 'ECR60X2Demo' (1 project) ECR60X2Demo GSYSTEM GOTION	Link To I/O Drive 1 (ECR60X2) # A Link To PLC	
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NC-Task 1 SVB Image Tables Objects Avis 1 Fr.c	Unit: mm -> Display (Only) Position: um Odulo Velocity: mm/min	
▷ 📲 Drive	Result	
Las Ctrl	Position: Velocity: Acceleration: Jerk:	
 Inputs Outputs 	mm mm/s mm/s2 mm/s3	
▲ 144 Axis 2 ▶ \$\$\$\$, Enc ▶ ≈+} Drive	Axis Cycle Time / Access Divider	
ter Ctrl	Divider: 1 Cycle Time (ms): 2.000	
Outputs	Modulo:	

Axis 1 自动链接至 ECR60X2 的 A 通道, 即 1 通道, Axis 2 自动链接到 B 通道, 即 2 通道。

Solution Explorer	
◎ ◎ 🏠 📇 - ™ - 🗃 🖋 🗕	General Settings Parameter Dynamics Online Functions Coupling Compensation
Search Solution Explorer (Ctrl+;)	ρ.
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Comparent and the second seco	Unit: Display (Only) Position:µm Modulo Velocity:mm/min
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1 Ctrl	Position: Velocity: Acceleration: Jerk:
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Axis 2	
Þ ➡ Drive	Axis Cycle Time / Access Divider
la⊾ Ctrl ▷ 🛄 Inputs	Divider: 1 Cycle Time (ms): 2.000
Outputs	Modulo: 0

2.4 驱动器设置

上述步骤成功后,此时驱动器处于"PREOP"状态,驱动器中间的绿色 LED 在快速闪烁。

State Mach	ine				
Init	В	lootstrap	1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	DREOR	
Pre-Op	S	afe-Op	Current State:	PREOP	
On		lear Error	Requested State:	PREOP	
- F					
DLL Status					
Port A:	Carrier /	Open			
	No Carri	er / Closed			
Port B:	A CONTRACTOR OF C				
Port B: Port C:	No Carri	er / Closed			
Port B: Port C: Port D:	No Carri No Carri	ier / Closed ier / Closed			
Port B: Port C: Port D:	No Carri No Carri	er / Closed er / Closed			

2.4.1 细分与电流设置

步进电机工作最重要的参数为工作电流及细分,参数设置如下:



0x2000 对象为轴 1 步进电机运行的正弦峰值电流,单位为 mA,用户需要依据负载设置合适的

电流值。不要超过电机的额定电流。

0x2001 为轴 1 电机运行一转所需要的脉冲数。

轴 2 的设置参数地址 = 轴 1 地址 + 0x800



2.4.2 保存参数

在对象 0x1010 的第一个子索引 (0x1010:01) 中,写入"1",将会把参数保存至驱动器。

注意: 在保存过程中, 电机将短暂停止输出力矩, 需要注意安全。操作如下图所示:



至此,步进电机的基本设置已经完成,可以接入工作模式。

2.5 运动控制轴设置

2.5.1 编码器设置

步进电机通常并没有编码器反馈,此处的设置任然借用虚拟的编码器设置,依据驱动器的细分及 机械传动机构,设定每一个脉冲对应电机运行的距离。

假设我们使用丝杆传动,导程为10mm,步进驱动器细分为10000脉冲/转。

则每个脉冲运行距离 = 10/10000 = 0.001(mm/inc)

如下图:



2.5.2 设置运动参数

设定好运动速度,加速度等参数,通常步进电机的加减速及最大速度较低,最大速度不超过

3000RPM,即 500mm/s。



2.6 激活设置及运动测试

2.6.1 激活

按照下图,激活设置:

CR60X2Demo - TcXaeShell								
File Edit View Project Build Debug TwinCAT TwinSAFE PLC Team	Scope Tools	Window Help						
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Search Solution Explorer (Ctrl+;)	<i>۹</i> -۹							
G Solution 'ECR60X2Demo' (1 project)		Parameter				Online Value		Unit
ECR60X2Demo		- Maximum Dynamics:						
SYSTEM	- 11	Reference Velocity			500.0	500.0	F	mm/s
A NC-Task 1 SAF	- 11	Maximum Velocity			500.0	500.0	F	mm/s
💼 NC-Task 1 SVB		Maximum Acceleration			5000.0	5000.0	F	mm/s2
🛟 Image		Maximum Deceleration			5000.0	5000.0	F	mm/s2
Tables		Default Duramiau			500010	500010		
Objects		- Default Dynamics:			4500.0	4500.0	-	
▲ ➡ Axis 1		Default Acceleration			1500.0	1500.0	F	mm/s2
🔺 👯 Enc		Default Deceleration			1500.0	1500.0	F	mm/s2
👂 😓 Inputs		Default Jerk			2250.0	2250.0	F	mm/s3
Outputs		+ Manual Motion and Hor	Activate Co	nfiguration	×			
▷ ➡ Drive		+ Fast Axis Stop:	Project:	ECR60X2Der	mo			
		+ Limit Switches:	Tarnet					
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🔺 🚔 Axis 2		+ Setpoint Generator:						
👂 👯 Enc		I NCI Parameteri		, C				
Drive				L	OK Cancel			
		+ Other Settings:						

此时提示是否进入 "Run Mode"

Microsoft Visua	l Studio	×
? Restart	TwinCAT System	in Run Mode
	确定	取消

点击"确定"

2.6.2 电机使能

此时驱动器 ECR60X2 的相关界面出现两个轴的控制界面,如下图:

Solution Explorer	* * ×	
○ ○ ☆ ☆ → ○ · ☞ ≯ - Search Solution Explorer (Ctrl+;)	- م	General EtherCAT DC Process Data Plc Startup CoE - Online Online NC-B: Online NC-B: Functions NC-A: Functions
Solution 'ECR60X2Demo' (1 project) Solution 'ECR60X2Demo MOTION P G SYSTEM MOTION PLC SAFETY C++ ANALYTICS NO POvice 1 (EtherCAT) Solution C++ Dovice 1 (EtherCAT) Solution P G Dovice 1 (EtherCAT) P G Dovic	1	O.0000Setpoint Position: mm] 0.0000Lag Distance (min/max): mm] 0.0000Actual Velocity: [mm/s] 0.000000.00

首先我们使能第一轴,按照下图,设置驱动器:

0.0000 Setpoint Position: mm] 0.0000 Lag Distance (min/max): mm] Actual Velocity: [mm/s] 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Override: [%] Total / Control Output: [%] Error: 100.0000 % 0.00 / 0.00 % 0 (0x0) Status (log.) Status (phys.) Enabling Calibrated Moving Fw Coupled Mode Controller Calibrated Moving Bw In Target Pos. Feed Fw 1 \$00 \$500 Set Enabling 1 \$500 Set Enabling Set Enabling 0 \$500 \$Set Enabling \$Set Enabling 0 \$Set Enabling \$Set Enabling \$Set Enabling 0 \$Set Enabling \$Set Enabling \$Set Enabling 0 \$Set Enabling \$Set Enabling \$Set Enabling 0	eneral EtherCAT [C Proc	ess Data Pl	c Startup	CoE - Online	Online	NC-B: Online	NC-B: Functions	NC-A: Online	NC-A: Functions
Lag Distance (min/max): mm] Actual Velocity: [mm/s] 0.0000 0.0000 0.0000 Override: [%] Total / Control Output: [%] Error: 100.000 % 0.00 / 0.00 % 0 (0x0) Status (log.) Status (phys.) Enabling Calibrated Moving Fw Coupled Mode Controller Set Has Job Moving Bw In Target Pos. Feed Fw 2 Controller Kv-Factor: [mm/s/mm] Reference Velocity: Set Enabling 1 \$500 Set Enabling UK OK 1 0 Ocorright Set Enabling OK 0 0 Oreginal Oreginal OK				0 0000	Setpoint Pos	ition:	mm]		1	
Lag Distance (min/max): mm] Actual Velocity: [mm/s] Setpoint Velocity: [mm/s] 0.0000 0.0000 0.0000 0.0000 0.0000 Override: [%] Total / Control Output: [%] Error: 100.0000 % 0.00 / 0.00 % 0 (0x0) Status (log.) Status (phys.) Enabling Ready NOT Moving Coupled Mode Controller Set In Target Pos. In Target Pos. Feed Fw Feed Bw Peed Bw Controller Kv-Factor: [mm/s/mm] Reference Velocity: Set Enabling 4 X 1 \$00 Target Velocity: 0 Output: Outpu: Output: Out				0.0000		C	0.0000			
0.0000 (0.000, 0.000) 0.0000 0.0000 Override: [%] Total / Control Output: [%] Error: 100.0000 % 0.00 / 0.00 % 0 (0x0) Status (log.) Status (phys.) Enabling Ready NOT Moving Coupled Mode Controller Set 2 Has Job Moving Fw In Target Pos. Feed Fw 2 Controller Kv-Factor: [mm/s/mm] Reference Velocity: Set Enabling 4 1 \$00 Target Velocity: Set Enabling 4 X 1 \$00 Output: OK Cancel Override [%]: Cancel 0 Override [%]: Cancel Override [%]: Cancel Override [%]: Cancel	Lag Distance (min/m	ax): mm]	Actual Veloc	ity: [mm/s] Setpoint Velo	ocity: [mm/s]			
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□ Has Job □ Moving Bw □ In Pos. Range □ Feed Bw Controller Kv-Factor: [mm/s/mm] Reference Velocity: 3 · · · · · · · · · · · · · · · · · · ·	Calibrated	Moving Fw	🗌 İn 🗍	larget Pos.	Feed Fw		2			
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1 500 Target Position: [mm] 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓ 0 ↓	Controller Kv-Factor:	[mm	/s/mm]	Reference V	elocity:		Set Enabling	4 >	<	
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0 Urride [%]:	Target Position:		[mm]	Target Veloo	ity:		Controller	ОК		
Override [%]:	0		L	0				Cancel	1	
Uvernee [3]:						-			1	
							Uverride [%]:	7	1	

此时第一个电机使能,这一步驱动器将完成锁轴,参数自识别功能,然后进入等待命令状态。 类似的步骤,下一步使能第二个轴:

860X2Demo +⊨ 2	×					_					
eneral EtherCA	T DC	Proc	ess Data	Plc Startup (CoE - Online Onlin	e NC-B	: Online	NC-B: Fu	nctions	NC-A: Online	NC-A: Functions
				0.0000	Setpoint Position:	mm] 0.0000	1				
Lag Distance (mi	n/max):	mm]	Actual Velo	ocity: [mm/s]	Setpoint Velocity:	[mm/s]					
0.0000	(0.000, 0	0.000)		0.0000	and the second second	0.0000					
Override:		[%]	Total / Co	ntrol Output: [%]	Error:						
	0.00	00 %		0.00 / 0.00 %		0 (0x0)					
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Controller Kv-Fac	ctor:	[mm	/s/mm]	Reference Ve	locity:	r 3.					
1			t	2200		Set Er	nabling	4	>	<	
Target Position: 0			[mm]	Target Veloci	ty:	✓ Co ✓ Fe ✓ Fe	ntroller ed Fw ed Bw		OK Cancel		
F1 F2	F	+ -3	++ F4		R F8	Overri 0	de [%]:		All]	

2.6.3 运动测试

按照下图提示, 点动控制电机运行

	0.0000	Setpoint Position: mm] 0.0000		
ag Distance (min/max): mm]	Actual Velocity: [mm/s]	Setpoint Velocity: [mm/s]		
0.0000 (0.000, 0.000)	0.0000	0.0000		
verride: [%]	Total / Control Output: [%]	Error:		
100.0000 %	0.00 / 0.00 %	0 (0x0)		
Status (log.)	Status (phys.)	Enabling		
Ready NOT Movir	ng Coupled Mode	Controller Set		
Calibrated Oving Fw	In Target Pos.	Feed Fw		
Has Job Moving Bw	In Pos. Range	Feed Bw		
ontroller Kv-Factor: [mm	/s/mm] Reference Ve	locity: [mm/s]		
	500	1		
arget Position:	[mm] Target Veloci	ty: [mm/s]		
00	1		依据指定的速度运行全指定位置	
F1 F2 F3	++ ↔ Ø F4 F5 F6	$\mathbf{R} \rightarrow \mathbf{F}$ F8 F9		

按照下图设置,可以让电机在0和5mm的位置之间以1mm/s的速度来回正反转测试:

			and a Deck		
	19.1	760	elpoint Position: [mm 19.1651	ו <u>ן</u> 	
xtended Start					
Start Mode:	Reversing Seque	ence 🗸	Start		
Target Position1:	0	[m n]	Stop		
Target Velocity:	1	[mm/s]			
Target Position2:	5	[m]			
Idle Time:	0.5	s	Last Time: [s]		
			22.94000		
aw Drive Output					
Output Mode:	Percent	~	Change		
Output Value:	0	[%]	Stop		
et Actual Position					
Absolute ~	0		Set		
et Target Position					
Absolute v	0		Set		

第三章 PLC 编程控制 ECR60X2

本章节利用 TwinCAT3.0 环境,设计了一个 PLC 程序。实现 ECR60X2 的两轴电机运行及 IO 功能测试。

3.1 添加 PLC 项目

在项目的 PLC 目录下,右键, Add New Item。

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在弹出框设置项目,我们选择 Standard PLC Project,其他使用默认设置,点击 "Add"完成

PLC 项目的添加。

Add New Item - ECR60X2Demo		? ×
▲ Installed	Sort by: Default	Search (Ctrl+E)
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3.2 **添加相关库**

在这一项目中,我们使用 EtherCAT 总线实现运动控制,并添加一个 HMI 界面控制测试的启停。 所以会用到下列模块。



在 References 目录上点击右键,选择 "Add library...",逐一添加上图所示的库文件。



3.3 程序

3.4 **关联输入输出**

默认 TwinCAT 已经将运动控制相关 PDO 映射好,我们需要将 Axis1 连接至驱动器正确的1 通道。

将 Axis2 连接至驱动器正确的 2 通道。下图是输入映射,输出映射原理相同

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我们需要将驱动器的 IO 设置好。我们利用驱动器的 4 路输出,将每路输出信号用于控制两个输入端口。

Y1 输出控制 X1、X5 并联, Y2 输出控制 X2、X6 并联, Y3 输出控制 X3、X7 并联, Y4 输出控制 X4、X8 并联, 这里需要将输出控制对象添加至 PDO。

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enera	l Eth	erCAT	DC	Proces	s Data Plc	Startup	CoE - Online	Online	NC-B: Online	e NC-B: Fu	inctions	NC-A: Online	NC-A: Functions	
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2	22	Out	p		0x1600	11.0	CHN 1 Receiv	e PDO 1		2	0			
3	22	Inpu	uts		0x1601	19.0	CHN 1 Receiv	e PDO 2			0			
					0x1602	15.0	CHN 1 Receiv	e PDO 3			0			
					0x1610	11.0	CHN 2 Receiv	e PDO 1		2	0			
					0x1611	19.0	CHN 2 Receiv	e PDO 2	-		0			
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							11.0							

下图是轴 1 输出端口 IO 映射



下图是轴 2 输出端口 IO 映射

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下图是轴1输入端口映射

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下图是轴 2 输入端口映射

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3.5 设计 HMI 即关联变量

设计了人机界面,用于启动测试,指示驱动器故障状态及 IO 测试情况



具体参考项目程序设计