# Weld

DUCO Robots CO., LTD.

Apr 28, 2024

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# CHAPTER ONE

### INTRODUCTION

In welding applications, direct communication between robots and welders is usually required to reduce communication delay and achieve better welding quality. The welding process package is divided into two parts, the setup of the welding machine and the application of welding instructions.

### **1.1 Adaptation Description**

Before the installation of the welding process package, it is necessary to ensure that the software version of the robot matches, specifically:

Robot control software version	V2.2.1 or later
Robot slave firmware version	V1.0.2 and above
Robot safety controller version	V2.1.0 and above

You can query the version information of the robot on the About interface after the robot is powered on. For how to open the "About" interface, see Section 7 of the DUCO CORE- User Manual.

For the welding process package V1.3 and above, the software version of the robot must be V2.7.0 and above

The current version supports the following welding machine models:

Welder manufacturer	Welder model	Communication protocol
Megmet	ArtSet Plus/Pro series	CAN

The current version supports laser sensors: Beijing Idea, Tangshan Yinglai, Suzhou Quanvision

### **1.2 Welding Machine Connection**

When using CAN communication, it is necessary to refer to the "Collaborative Robot User Manual (Hardware part)" and the welding machine manual to connect the CAN communication interface of the two. In order to ensure the communication quality, it is usually necessary to parallel a 120 $\Omega$  terminal resistor at the interface to eliminate signal reflection. Take Magmet ArtSet Plus/Pro series welder as an example:

1. Query "User Manual of Collaborative Robot (Hardware part)" and find the CAN communication interface, as shown in the following figure:

	17 33+- 50+-	
编号₽	信号定义↩	复合应用₽
142	AI_C1₽	电流模拟重输入 1-2
2+2	AGND42	模拟地↩
3.₽	AI_C2+	电流模拟重输入 2-2
40	AGND42	模拟地↩
5+ <sup>2</sup>	AI_C3+	电流模拟重输入 3-2
<mark>6</mark> 4 <sup>3</sup>	AGND47	模拟地₽
7+2	AI_C4+2	电流模拟重输入 4~
<mark>8</mark> 42	AGND42	模拟地↩
9+2	AI_V1↔	电压模拟重输入 1-2
1040	AGND42	模拟地↩
110	AI_V2+	电压模拟里输入 2+2
12¢	AGND42	模拟地₽
130	AI_V3₽	电压模拟量输入 3+2
140	AGND42	模拟地↩
150	AI_V4+2	电压模拟量输入 4~?
1640	AGND47	模拟地₽
17¢	空₽	空 <sub>4</sub> ,
1840	CAN_H₽	
1940	CAN_L+	CAN 通讯↩
20+2	CAN_GND+	
214	R5485_A+	₽S485 通讯⊿
234	RS485_GND¢	200700 <u>Jm</u> HV.
	-	· · · · · · · · · · · · · · · · · · ·

As the table, CAN communication uses pins 18,19,20

2, query the welding machine manual, find the welding machine side CAN communication interface, as shown in the following figure:

#### 71 第五章 机器人通讯接口

表 5-4 航空插51脚定义										
引脚编号	颜色	信号名称	功能							
1	紅(18AWG)	24V 电源	机器人电源信号							
2	白(22AWG)	CAN_H 信号线	通讯线 CAN_H							
3	黑(18AWG)	地	机器人电源地							
4	蓝(22AWG)	CAN_L 信号线	通讯线 CAN_L							
5	屏蔽线(18AWG)	屏蔽线	外壳 PE							
	<b>注音</b>									
/										
早接电源提	供 24V 供 电, 若 机器 人 有 24V, 此	电源不接;								

3. According to the instructions of the robot and welding machine, connect the white wire of the welding machine to the 18th pin of the robot expansion interface, connect the blue wire to the 19th pin of the robot expansion interface, and connect the black wire to the 20th pin of the robot expansion interface.

### 1.3 Process Package Installation and Uninstallation

数字口高低电平间要求并上120 欧电阻,若机器人已有此电阻,不需再匹配电阻。

The welding process package file is the plug-in of weld.plugin. The installation procedure is as follows:

- 1. the welding process package into the U disk, U disk requires FAT32 format
- 2. After the robot system is started, insert a U disk into the USB interface on the robot control cabinet.



3. Log in to the robot system as user admin.

● 待机	工程 jiayou	安装 模装	工具 xipan 10k	g 工件 default	速度 70%	手动模式	真机	證證 27 安全校验 ▲ L3 28 c8 c3
		naster N/A	^	运行状态 Stopped	本次运行时间 23:22:45		C C	admin admin
概题	¥ 2 %				<b>D</b> #	en ill.	A 17	✿ 系统设置
◆◆ 移动				E464	49.4%	Ξ₽	▲ 账号管理 0 关于	
>					13:33:04 inf	fo admin login		注销
\$	+	2			13:32:22 error 0x00010106 gett0393 Etherninot exi			关机
接口 <b>借</b>	-//			Ħ				11C
日志				$\rightarrow$	关节位置	空间位置 10t	たち 电消	1信息 力信息
ф.					关节1	38.47°	关节 4	62.35°
					关节 2	-27.32°	关节 5	52.51°
时间 13:35:27	► N/A	20 <b>5</b> 2		14.7	关节 3	-50.20°	关节 6	51.88°

4. Click the user profile picture

() 1981.	) II	安装	I	工件	速度	TE Phillipp	御和 L3	₹ 28c3
				系统设置			×	WHICH TAKE
Ģ		语言设置						2225:55:20
6335		网络设置	◎ 简体中文	O English	〇 日本語	和定		
€Z,2h		更新						
		时间设置					set失败; nterface	The given
程序		插件管理					mp4s0	- Harrie Goes
\$	+	机器人参数						
(日本) 日本		云平台 未连接					·思失败; 由源值[	The given
۲	=							7712-0
12		恢复出厂设置					1	62.35°
								52.51°
9+67					关节 3	-50.20°	关节 6	51.88°
13:38:08		2201		14.7				

, select System Settings.

● 待机	IN JAC	安装	I. IR	工件	速度	15 Rhilling	南机	○ 世代報 ○ 世代報 ○ 日本 ○ 日本
				系统设置			×	
		语言设置	已安装插件					2225:59:49
4355		网络设置	Conveyor					
<b>+</b>		更新						×
ন্দ্র গ্র		时间设置						意失败:The given
程序		插件管理	200-000./ev fB					mp4s0
<b>\$</b>	+	机器人参数	PT-1001D-024					
(日本)	-#	云平台 未连接						1息失敗:The given - 电源信息 力信息
0 1911		恢复出厂设置				添加	翻除	62.35°
时间 13-42-38	► N/A	. tott		14.7	关节 3	-50.2	20° 关节	6 <b>51.88°</b>

5. Select the plug-in management function.

<b>()</b> 1981	IN IN		22   IA	I.I.#	通常	IE RANKE VP.	盲机		予定金校验 (8c3 (8c3)
	<>>			茶桃设置					服机运行时间
Ф		语言的	请选择文件:			×		22	26:02:18
÷	JI N	更新	🗅 Backup						
移动 >		时间场	🗅 riben					绿失败:打开	Fusb文件
程序		1664×18	geely.plugin			_		3思失敗:The	e given
い 第日	+	机器人	weld.plugin					nterface na enp4s0	ame does
Et a	Ħ	云平台						电源信息	力信息
(2) (2) (2) (2) (2) (2) (2) (2) (2) (2)		恢复						1	62.35°
			返回 刷新		取消	选择		ţ	52.51°
时间 13:45:07	► N/A		tati	14.7	关节 3	-50.20°	关节	6	51.88°

6. Click the Add button.

	IN jir		安教 工具		速度	IE Shill ve.	面和		7 安全校验 c8c3
			3	系统设置			×		整机运行时间
Ģ		语言话				×		22	26:02:18
4535	i c	网络话	请选择文件:						
◆ 総計		更新	🗅 Backup						
		时间该	🗅 riben					(表失败:打开	Fusb文件
程序		新件智	geely.plugin					TRAD TH	aium
<b>t</b>	+	机器人	weld.plugin					nterface na enp4s0	ame does
Ö	_ <del>_</del> _								-
日志	$\neq$	云平台						电源信息	力信息
<b>②</b> 没置									62.35°
		恢复是	返回 刷新		10/H	选择		5	52.51°
				_	关节 3	-50.20°	关节	6	51.88°
时间 13:45:07	► N/A		120d	14.7					

7, select the USB flash drive and from the file list, find and select the weld.plugin package.

● 待机		e s	● 安装成功		1	lane. Wh	1 過推 2 安全 L3 2 68	c3
C All X		语言设置	已安装插件				2226:0	1599月 3:34
÷		网络设置	Conveyor					
移动		更新	Weld			2		
/>程序		时间设置					l表失败:打开usbS	2件
\$		插件管理	详细体息				自住於The giver	
披口	+	机器人参数	name: Weld	1			nterface name d mp4s0	Des
日志	_7		author: SIASUN description: 弧焊工艺包					-
۲	=	云平台 未连接		-			电源信息 力信	
設置								
		恢复出厂设置				添加 删除	52.5	55"
311.12					关节3	-50.20° #1	56 51.8	88°
时间 13:46:23	► N/A	tat	2	14.7			514	

8. After the plug-in package is installed, 2 will be marked as shown in the following figure. Newly installed plug-in packages will be enabled by default at 2. 2 displays the name and version of the current plug-in package.

()	工程 jiayou	安装 模装	工具 xipan 10	上侍 default	速度 70%	手动模式	真机 <sup>截触</sup>	常安全校验 ▲ c8c3	
口 概范		当前运行程序 N/A	~	進行秋本 Stopped	0	本次進行时间 23:43:56	0	雅机遗行时间 2226:13:49	
<b>◆</b> 移动	۳. ۲		j		日志	呼级:	全部	~	
程序					13:44:22 error 0x00010801 载入文件列表失败:打开usb文件 夹失败				
<b>は</b> 19日	+		Lune .		13:38:01 error 0x00010106 获取网络信息失敗:The given Ethernet interface name does				
<b>日</b> 志	-77			₽	not exist:enp4s0				
<b>ि</b> 12.11					关节位置	空间位置	の状态 电源信息	息 力信息	
	_//		1		关节1	38.47°	关节 4	62.35°	
31.19					关节 2	-27.32°	关节 5	52.51°	
时间 13:56:38	► N/A	hote		14.7	关节 3	-50.20°	关节6	51.88°	

9. After the welding process package is installed, the process package setting portal will appear at the lower left of the main interface.

<ul><li>● 待机</li></ul>	工程 *jiayou	安装 横装 ;	工具 xipan 10kg	工件 default 70	I度 0% 手动模式	真机 甜糖 ₽ 安全核验 ▲ L3 ピ c8c3 ▲
反戦范	焊机设置	焊接设置	工艺文件	焊接保护	焊机信号	
◆◆ 移动	焊机连接状态	$\bigcirc$				
>程序	焊机品牌	麦椙米特	~			
<b>は</b> 第日	成 項 明 近 特 本	ArtSet Plus/Pro涨列 125	~			
<b>Ü</b> 88	自动连接	OFF				
<b>(2)</b>		连披				
\$11,12						
时间 14:10:22						

10, click the process package setting entry button, you can enter the welding process package setting interface.

() (ötl	IS jir	安教	IA	IM	速度	王 sh相 st	盲和、	○ 総理 L3	2 安全校验
			系	统设置			×		
		语言设置	已安装插件					22	26:20:33
÷		网络设置	Conveyor						
移动		更新	Weld						
<b></b> 程序		时间设置						悲失败:The nterface na	e given ame does
3		插件管理	详细信息					np4s0	
接口	+	机器人参数	name: Weld					想失敗:The nterface na	e given ame does
日志	_7		description: 近焊工艺包					mp4s0	
() ()	=	云平台 未连接						电源信息	力信息
		体复出厂设置				124	8056	s	62.35°
511.12					_	78×10	BERK.	;	52.51°
					关节 3	-50.2	20° 关节 (		51.88°
14:03:22		2055		14.7					

11. The welding process package that has been installed can be temporarily disabled by turning off the enable signal. Or click the Delete button to delete the package completely.

# CHAPTER

# WELDING PACKAGE SETTINGS

Welding process package Settings, including welding machine Settings, welding Settings, process files, welding protection, welding machine signals.

# 2.1 Welder Settings

Welder Settings Used to display communication status, configure the welder model and corresponding communication Settings.

焊机设置	焊接设置	工艺文件	焊接保护	焊机信号
焊机连接状态	$\bigcirc$			
焊机品牌	请选择	× 1		
焊机型号	请选择	$\sim$		
通讯波特率	125	~		
自动连接	OFF			
	连接			

Welding machine connection status: When the communication between the robot and the welding machine is established, the status indicator will turn from gray to green. As shown in the picture below:

焊机设置	焊接设置	工艺文件	焊接保护	焊机信号
焊机连接状态	•			
焊机品牌	麦格米特	~		
焊机型号	ArtSet Plus/Pro系列	~		
通讯波特率	125	~		
自动连接	OFF			
	连接			

Welder brand and model: Used to configure the current welding machine. After selecting the welder correctly, the robot will invoke the corresponding communication protocol.

On the welding machine side, it is necessary to refer to the welding machine manual, adjust the control mode of the welding machine to the robot control mode, and select the corresponding communication protocol. Take Magmet ArtSet Plus/Pro series welder as an example:

1. 按下左循环键,选择网络 N00;

2. 旋转左旋钮,选择相应的协议。

NOO 的协议详见表 4-7。

协议号	合作方	应用层协议
FAN	发那科	DeviceNet
ABB	ABB	DeviceNet
CCA	库卡	DeviceNet
CRP	卡洛普	DeviceNet
CHF	柴福	CanOpen
TUR	图灵	CanOpen
ANC	安川	DeviceNet
GSD	广数	DeviceNet
FNE	发那科	Ethernet/IP
CHQ	川崎	Ethernet/IP
HYD	现代	DeviceNet
GOG	固高	CanOpen
SIA	新松	DeviceNet
KBA	KEBA	CanOpen
ANG	/	模拟口

表 4-7 协议对应表

The communication protocol of the welding machine needs to be modulated to GOG mode, and the N00 parameter is set to GOG. At the same time, the function of the robot communication module is activated, and the P05 parameter is set to On.

#### 4.1.3 机器人通讯模块激活(P05)



Communication baud rate: Used to set the baud rate of CAN communication, supporting 125kbps,

250kbps, 500kbps three baud rates. It should be noted that the baud rate of the robot and the welding machine needs to be set consistent in order to achieve communication. Take Magmet ArtSet Plus/Pro series welder as an example:

### 4.2.4 机器人通讯波特率(NO4)



图 4-46 N04 显示界面



- 1. 按下左循环键选择网络,旋转左旋钮,选择 N04;
- 2. 旋转右旋钮, 选择相应的波特率, 范围为 125kbps、250kbps、500kbps, 默认值 125kbps。

The baud rate of the welder N04 parameter should be consistent with that of the robot.

Automatic connection: It is used to automatically connect the welding machine when the robot starts up next time. When it is set to ON, the robot will save the current setting information, and the next time the robot starts up, it will automatically connect the welding machine after the robot completes the power-on operation of the robot.

Connection: The "Connect" button is usually used when the robot communicates with the welding machine for the first time. Click the "Connect" button to send a connection request to the welder according to the message format of the welder. After receiving the correct feedback from the welder, the welder connection status light turns green.

### 2.2 Welding Settings

Welding Settings used to set welding mode, arc parameters, manual debugging function of the welder trigger and current and voltage display of the welder.

(36)	工程 project_1 空装	工用 defa 0kg	□ 注作 default 70% 手动模式 真机 炭 ピ Scce A
	焊机设置 焊接设置	工艺文件	焊接保护 焊机信号
中の	焊机设置		焊机操作 焊接使规 OFF
◆ 移动	焊接模式 直流一元化 ~		点动送丝 焊丝反抽 保护气险则
	分别模式 分别模式 ~		焊机状态
E S	起弧参数设置		
披口	起劲如此则时间 2000		
<b>⊟</b> ≋	起張重复次数 3		165 220 <sup>275</sup> 330 385 15 20 25 30 35 15 10 40 -
٢	当前设置的焊接参数		
设置	焊接电流(A) - 19	6 +	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	焊接电压(V) - 0.0	5 +	per van "soone per soone p
6	启用焊接空跑倍率		
92,94	ON		
时间 18:29:07			

Welding mode: used to set the working mode of the welding machine. When setting, the corresponding communication data will be sent to the welding machine to switch the operating mode. It should be noted that whether the setting can be successful also depends on whether the communication protocol of the welder supports modification. If the communication protocol of the welder does not support it, the same setting needs to be performed manually on the side of the welder. The welder mode that can be set is shown in the following figure:

焊机设置	
焊接模式	直流一元化 ^
分别模式	直流一元化
	脉冲一元化
起弧参数设置	JOB模式
起弧检测时间	断续焊
起弧重复次数	3

Take Magmet ArtSet Plus/Pro series welder as an example:

#### 4.1.1 焊接电源控制模式选择(P02)



图 4-1 P02 显示界面



- 1. 按下左循环键选择"程序",旋转左旋钮,选择 P02,默认为 F;
- 2. 旋转右旋钮,选择相应控制方法。焊接电源控制模式说明见表 4-1。

表 4-1	控制模式说明
-------	--------

显示	F	N	DF	DN
控制模式	送丝机控制	电源显示板控制	机器人一元化控制	机器人 JOB 调用控制

#### (1) 注意

- F:送丝机板控制模式,指的是在 JOB 号为"10"时,送丝机控制的信号有焊枪开关、点动送丝、气体检测、主送丝速度和主弧长系数,其余参数由电源面板设定。
- 2. N: 焊接电源显示板控制模式,送丝机控制的信号有焊枪开关、点动送丝、气体检测,其余参数由面板设定。
- DF:机器人一元化控制,指的是在 JOB 为"10"时,机器人控制的信号有焊枪开关、点动送丝、反向抽丝、气体检测、故障消除、主送丝速度和主送丝速度弧长系数,其余参数由电源面板设定。
- 4. DN:机器人 JOB 调用控制指的是机器人的调用通道控制焊接过程,机器人控制的信号有焊枪开关、点动送丝、 反向抽丝、气体检测、故障消除及 JOB 号,其余参数由电源面板设定。

If the DC unified mode is used, in addition to selecting the DC unified mode on the robot side, the P02 parameter needs to be set to DF on the welder side. If the JOB mode is used, set this parameter to DN. At present, the communication protocol does not support pulse unified and intermittent welding, so it is necessary to save the pulse unified parameters or intermittent welding parameters in JOB mode at the welder side, and then invoke the robot in JOB mode to realize the corresponding welding mode.

Separate mode: This parameter is used to set the current and voltage parameter setting mode of the welding machine. It supports separate mode and unified mode. As shown in the picture below:



When using separate modes, the unit of current is A and the unit of voltage is V. When using the unified mode, the unit of current is A and the unit of voltage is %. The setting of this parameter will affect the welding voltage unit of the current welding parameters, process files, welding machine signal interface and arc starting/closing parameters in the program script.

Taking the adaptation of Magmet ArtSet Plus/Pro series welder as an example, it is also necessary to set the N11 parameters on the side of the welder, as shown in the following figure:

# 4.2.11 网络参数选择(N11)



图 4-53 网络参数 N11 显示界面



- 1. 按下左循环键选择网络,旋转左旋钮,选择 N11;
- 2. 旋转右旋钮, ON 为分别模式, OFF 为一元化模式, 默认 OFF。

Arcing Settings: You can set the arcing detection time and the number of arcing repeats. The unit of arcing detection time is ms. After sending the arcing command, the robot will monitor the successful arcing signal returned by the welder. If the successful arcing signal is not received within the detection time, the arcing command will be re-sent. The number of repetitions is set by the number of arc-starting repetitions.

Currently set welding parameters: change the current and voltage value of the welder in real time. It is usually used in the test welding stage to adjust the current and voltage to find the combination of parameters in line with the process. The set of parameters are the current and voltage parameters actually sent to the welder at present, and have nothing to do with the set values in the program script and process file. For example, after ArcStart is run, this value becomes the parameter set by the ArcStart function block.

Welding idle rate: Enable button for welding idle function. After the function is enabled, when the welder is not enabled, the robot is allowed to run at double speed to quickly observe the correctness of the welding trajectory. The magnification is set in the welding program script.

Welder enable: The enable signal of the arc starting function of the welder. If off, the arcing command will no longer be executed when the robot program is run.

Point wire feeding: button long press trigger, control wire feeding machine, button release will stop wire feeding.

Welding wire reverse pumping: the button is triggered by long press to control the wire feed machine, and the button is released to stop the wire.

Protection gas detection: control the welding machine air valve open, used to test whether the normal gas supply. Taking Magmet ArtSet Plus/Pro series welder as an example, the air valve will be automatically closed by the welder after opening 30 seconds. If you click again midway, turn off the air valve.

Welder status: real-time display of welder feedback welding current and welding voltage. The unit of welding current is A, and the unit of welding voltage is V.

# 2.3 Process Document

Process files for setting and saving welding currents and voltages for starting and closing arcing. Click "arcing process file" and "arcing process file" to switch process file types. Click "New" to create a process file of the corresponding type. Enter the process file name and click "OK" button to complete the new process file.

	杨矾	] I jiaj	en nou	\$ \$	it in kip	工用 an 10kg	工件 default		速度 70%	手动模式	真机	副推 L3	2 安全校验 C8c3
ロの		焊机	9 <b>2</b>	焊接	RM	工艺文件	焊	18(93)	焊机信号	6.			
		総加工艺	这件 这件	所有文件 arc_start	1		\$FER						
				arc_start	2		•••						
は 第日													
输入工艺	文件名												
	1	2	3	5 4	» 5	Ĝ	* 7	8	9	) 0	:		⊗Esc
	q	w	•	r	t	у	u	i	•	р	)	1	$\lambda$
		a	s	d	f	g	h	j	k	1	;	:	
	Shi	ift	z	x	c	v	b	n	m	<	> ? . /	/	-
										<	>	0	ĸ

Click File, the input box of welding current and welding voltage will be displayed on the right side. The unit of welding current is A, and the unit of welding voltage will be determined by the setting of the respective mode. See the respective mode Settings. Click "Save" to record the welding current value, welding voltage value and the mode type set during the setting.

焊机设置	焊接设置	工艺文件	焊	接保护	焊机	信号		
起弧工艺文件	所有文件	*	斤建	起弧参数	¢			
收弧工艺文件	arc_start1		•••	焊接电流	(A)	0		
	arc_start2		•••	模块由压	0.0	0		
	arc_start3		…	7年1年1月1日1日1	(*)	0		
							保存	

If the current welding separate mode Settings are inconsistent with the separate mode Settings selected during process file generation, a pop-up will remind you. As shown in the picture below:

绿机设置	焊接设置	IZ文件 #	建保护 焊机	信号	
183112文件	所有文件	新建	起弧参数		
收弧工艺文件	arc_start1		焊接电流(A)	120	
	arc_start2		焊接电压(%)	2	
	arc_start3	警告	当前设置的不一致	× क्षेत्र	

### 2.4 Welding Protection

Welding protection is the protection function in the welding process, the principle is:

Real-time monitoring of the tool end of the robot whether there is more than the monitoring displacement. If the end of the tool of the robot does not produce enough displacement within the set monitoring time, it is judged that the robot is in the same position, and the arc closing command of the welder will be triggered. The purpose of this function is not to allow the robot to have a long welding operation in the same position, in case the weldment burns through.

焊机设置	焊接设置	工艺文件	焊接保护	焊机信号
焊接位置保护	OFF			
监控位移(mm)				
监控时间(ms)				

# 2.5 Welder Signal

<ul> <li>(a)</li> </ul>	工程 project_1	<sub>会装</sub> 変装 defa 0kg	工件 default 70% 手助模式 真机 発想 の 完全校論 A
	焊机设置	焊接设置 工艺文件	焊接保护 焊机信号
東観流	焊机信号	寄存器	
+	焊接使能	bool_reg_out 17	0
8(F-57)	焊机准备就绪	bool_reg_out 18	
程序	焊机起弧成功	bool_reg_out 19	
\$	焊机故障	bool_reg_out 20	
渡口	电弧异常	bool_reg_out 21	
<b>⊟</b> ≉	其他流量异常	bool_reg_out 22	
۲	粘丝	bool_reg_out 23	
iQ. <u>m</u>	实际焊接电流(A)	float_reg_out 1	12
	实际焊接电压(V)	float_reg_out 2	3
	焊机错误码	word_reg_out 1	345
31,12			
1410			
18:28:10			

The welding machine signal page is used to display the welding machine signal, and configure the signal to the register, so that the upper controller of the robot can obtain the welding machine information

through profinet, modbus, TCP/IP and other ways. tap to perform register configuration, and a list of configurable registers will be displayed on the right side of the signal, as shown below:

⊘

焊机设置	焊接设置 工艺文件	焊接保护	焊机储带	
算机服务	寄存器 (			
焊接使能	bool_reg_out17 ^			
焊机金备弛增	bool_reg_out10	0		
大学市1月23日1月27日	bool_reg_out11	0		
焊机故障	bool_reg_out12	0		
电弧异常	bool_reg_out14	0		
其他洗量异常	bool_reg_out15			
#210	bool_reg_out16			
1112	bool_reg_out17			
实际焊接电流(A)	float_reg_out1 ~~	12		
实际焊接电压(V)	float_reg_out2 ~ ~	3		
焊机撤误码	word_reg_out1 ~	345		

Once the register configuration is complete, click

to save the configuration.

### 2.6 Sensor Settings

The Sensor Settings page is used to set the laser sensor manufacturer, connection sensor, control sensor, and calibration sensor. In the figure, the left area is used for sensor connection and operation, and the right area is used for viewing calibration parameters and calibration of the laser sensor. See Section 7 Laser Tracker for specific use

**##	1程 project_1 2課   1R   1件 22課   defa 0kg   default 100% 手动模式 真机 日本 c51b
Premium &R	焊机设置 焊接设置 I艺文件 焊接保护 焊机信号 传乐器设置
口板花	传感器连接状态
◆ 移动	传感器设置
40	传感器品牌 北京创想 ~
程序	IP地址 192.168.2.3
<b>\$</b> ₩□	\$A□ 502
<b>₿</b> 8	传感融操作
0	打开跟光 先闭跟光 使能 新使能
in the second se	新期(1993年) 第
100 100	操 健 <del>无效</del> 左右编移(mm) 0 上下编移(mm) 0 焊確完度(mm) 0 焊確完度(mm) 0 当前参数 1

# CHAPTER THREE

# WELDING APPLICATIONS

# 3.1 Arc Starting Conditions

The robot sends the arc signal to the welding machine, which needs to meet four necessary conditions:

(96)	<u>ІЩ</u> * <i>ј</i> шуои	交換 <b>整装</b>	工具 xipan 10kg	工作 default	IRR 70% 手动器	et An	L3	C8c3
<b>口</b> 版改	焊机设置	焊接设置	工艺文件	焊接保护	探机信号			
◆◆ 終助	焊机设置			焊机操作	焊接使能 ON			
	焊接模式	直流一元化 ~		用动送丝	焊丝反抽    保	時代位別		
程序	分别模式	分别模式 ~		101010				
お	起现参数设置			增机状态				
<b>₿</b> 8	自己的标合因同时间	1500						
۲	超紅星媒次数	3			145 220 375 330 385	Si	20 25 30 35	
12M				- 2	10 440- 5 405 -	- 10	1	45 -
1				•	0	• - 0	0	~
90,17					神後也に		MARINE	
时间 21:30:29								

1, welding enable signal open

- 2, the robot movement mode is automatic mode
- 3, The robot's global speed is set to 100%
- 4, in the robot script, there is an arc script

	工程 *jlayou	· · · · · · · · · · · · · · · · · · ·	IR IM pan 10kg default	送席 100% 自动	and the second	(81. L3	₽ \$26\$ c8c3
	۲	Leon	0621.jspf*[只读]	Ba	开程序	56 (65K	保存程序
₩.8 ⊕	1 -	主程序		源加	文皇	9 <b>2</b>	這行
853)	2	🕂 Start			起弧		Î
12.9	3	+ Move		<ul> <li>选择起弧工ま</li> </ul>	艺文件 回译		
<b>は</b>	5		]				=1
Ö	6	Move			起弧参	故	
88	8	MoveL wp2		焊接电流(A)	120		
ex.	9	ArcEnd		THE REPORT (V)	20		
1		_			Job模式	對政	
31,14						RUH	14.2
时间 21:35:52							

# 3.2 Arc Starting and Ending Function Blocks

(9) (9)	⊥® *jiayo	v 交統 工具 工作 変張 xipan 10kg default	選渡 100%	手动模式	л <mark>ана</mark> 🖉	68c3
<b>Q</b>	<	Leon0621.jspf*		日打开程序 開	A Mar	保存程序
+	1	主程序	18.20	交量	伊政	运行
移动 2</td <td>2</td> <td>🕂 Start …</td> <td>A</td> <td>Conveyor</td> <td>8</td> <td><sup>133</sup> -</td>	2	🕂 Start …	A	Conveyor	8	<sup>133</sup> -
808 C	3		- 15	to fact	3	50 568
HE I	6	+ Move ···	42	Arcstart	25	2 19280
日志	7	MoveL wp1 ····	Φ	ArcEnd		
0 1211	8	MoveL wp2 ····     ArcEnd ····			2	£R. ₽
7		_				542
31,10					3	
时间 23:11:11					4	+

After the welding process package is installed and the plug-in package is enabled, two new program function blocks ArcStart and ArcEnd will be added in the extension function script bar of the robot program interface.

	<	ar	c.jspf	已打开程序 撤销 恢复 保存程				
	1	主程序		添加 支量 參数 运行				
□	2	🕂 Start		起弧				
÷	3		)					
多动	4	+ Move		THE TREAMER OF				
	5	🕂 MoveL w	p0	起弧参数				
<b>\$</b>	6	🕂 MoveL w	p1 •••	焊接电流(A) 15				
\$D	7	88 Wait		焊接电压(V) 10				
□ ∃あ	8	♦ ArcEnd						
٥				Job模式参数				
RM				Job뮹 41				
				设置空夠倍率				
				倍率(1-10) 5				

The arc starting/closing block allows the arc starting/closing instructions to be sent to the welder in three different modes. They are the methods of calling the process file, setting the arc starting parameter, and setting the JOB number. In the arc starting function block, the magnification can also be set during idle running, so that the robot can run at high speed when the welding function is not enabled, so as to quickly observe the correctness of the welding trajectory during debugging. In the welding process, it is necessary to change the welding parameters during the operation of the robot, which can be achieved by setting two arcstarts.

#### Select arcing/closing process file:

When selecting process files, ensure that the welder control mode is DC unified, see the welding Settings section for details. Check the check box first when using, as shown below:

	IS jiayo	安然 空間	工用 xipan 10kg	工件 default	i肥度 100%	手动模式	<b>真机</b> L3	28c3
	<		ttt.jspf*			已打开程本	1010 (15.00	保持程序
<b>中</b> 概述	1	主程序			源加	交量	学政	运行
	2	🕂 Start				赵	200	Î
40	3		irt		105 (4230)	工艺文件 选择		
税序	4	+ Move					_	
	9	ArcEn	i			起初	参数	
Ð					焊接电流(A)	0		- 11
0					焊接电压(V)	0		- 18
RE								
					lah E	Job複	式参数	
6					10045	0		
2624							10214	100
时间 08:43:43								

When the check box is displayed, the parameters in arc starting parameters and Job mode parameters become gray and cannot be edited. Click "Select" to select the process file, as shown in the picture below:

() (H)	IS Jayou	安康 工県 工作 登装 xipan 10kg default	送票 100% 手动模式	東の 品 記念法はない
	•	ttt.jspf*	已打开程序	1000 032 G3762#
15.20	1 1 主程序	请选择文件;	×	学校 运行
€ 88-30	2 🕂	🗎 arc_start1		1830 A
40 記字	3 (¢	arc_start2		
<b>ដ</b>	9 (P)	arc_start3		系统教
Ö				
0				
22				載式参数
		道回 · 刷新	ACH ANN	
91,9				
时间 09:00:29				

After the process file is selected, the welding parameters in the process file will be displayed in the gray arcing parameters, and the parameter units are related to the respective modes set. As shown in the picture below:

	<			ttt.jspf*		已打开租床	3014 (7.5	R (R1982)
<b>.</b>	1	- 11	见序		源加	交景	学取	运行
⊕ 530	2	+	Start			超	π	
(J)	3	45	ArcStart		■ 洗择約個丁	艺文件 洗浴	arc start2	
2098	4	• 🕂	Move				)	
<b>;</b>	9	42	ArcEnd			起机机	嫩	
3					焊接电流(A)	120		
18					焊接电压(V)			
27 27								
						Job横式	参数	
					与dol	0		

If the selected process file has a different mode from the currently set mode, a pop-up will remind you.

		工程 jiayou		(注注) <b>英型</b>	工用 xipan 10kg	I# default	速度 100%	手动模式	<b>政</b> 和 L3	
	<				ttt.jspf*			日打开程序	1016 (V.S.C	保存程序
2538	1		主程	序			16.20	交量	学数	运行
<b>∲</b> 移动	2		÷	Start				起	300.	Í.
40 税余	3		\$	ArcStart			×	工艺文件 选择	arc_start1	
5	9		4.	ArcEnd	工艺文	警告 🛈	2置的不一致	153	参数	
Ë						alize		120		
								2		
RE								Job横	式参数	
							Job			
31,12									Rota	
时间 11:04:39									404	

Arcing/closing parameters:

When choosing arcing/arcing, ensure that the control mode of the welder is DC unified. For details, see the Welding Settings section. The process file check box cannot be selected, and the Job mode parameters are gray and cannot be edited. Parameter units are related to the respective modes set.

Job mode parameters:

When selecting the Job mode parameter, ensure that the welder control mode is Job mode. For details, see Welding Settings. When the parameter is set to Job mode, the process file and arc starting parameters are gray and cannot be edited.

() 4541.	1R jlayou		200 工用 支援 xipan 10kg	工件 default	送席 100%	abenet (	截和 L3	2 安全校社
	٢.		ttt.jsp	f*		已打开程序	<b>撤销</b> 依规	保存程序
東	1 -	主程序			爆加	交量	923	运行
+ ● 移动	2	🕂 Star	t			起劲	u.	Î
/> 程序	3	4) *Ar	cStart •••		日选择起机工	艺文件 18.15	arc_start1	
<b>\$</b>	9	Arc	End			1251.6	财	-1
Ü					焊接电流(A)	120		- 1
©					焊接电压(V)	2		
12.00						Job模式	(参数	
10.19					身doL	10		
810 11:12:46							ROR	ata

Set the empty run ratio:

After the empty run ratio is set, when the empty run function is turned on and the welder enable is turned off in the welding setting, all robot motion scripts between ArcStart and ArcEnd will be run at a rate of magnification. The actual speed of the robot will be multiplied by the set multiplier. The calculation formula is:

Actual operating speed = set welding speed \* Manual/automatic reduction ratio \* Global speed \* magnification

For example, set the welding speed to 20mm/s, set the global speed to 70% in manual mode, and set the idle speed to 3:

Among them, the manual reduction ratio is 25%, and the automatic reduction ratio is 100%.

Actual operating speed =10.5 mm/s.

For example, the welding speed is set to 20mm/s, the global speed is set to 80% in automatic mode, and the idle speed is set to 3:

Among them, the manual reduction ratio is 25%, and the automatic reduction ratio is 100%.

Actual running speed =42mm/s.

### 3.3 Swing Welding

<b>9</b> 1351	pro	工程 ject_AS 型詞	工用 default 4.13999	工件 wobj01	18.12 30%	手动模式	<b>Д</b> ИЛ 13	€ <sup>2</sup> c8c3
DUCO CORET Presiden B.R.	<		rrr.jspf*			已打开程序	RM (12	998*
Q.	1	▼ 主程序			35.50	2.R	伊政	遗行
÷	2	🕂 Start			sp	Conveyor		•
移动	3	🔍 🕂 Move				,		移动
409 1209	4	🕂 MoveJ w	p0 •••		ф.,	ArcStart		88
\$	5	+ Movel v	vp1 •••					2545
18C	6	ArcStart			42	ArcEnd		•
88	7	Veave Weave						加程控制
۲	8	V 🕂 Move			45	Weave		通讯
iQ.M	9	🕂 Movel	wp2 •••					0
	10	🕂 Movel	wp3 •••					高级
91.9	11	🚸 ArcEnd						
町间 09:19:33	12	88 Script						5 M

Welding process package V1.2.0 and above, adding pendulum welding function. In the "Extension" instruction set in the programming interface, call the "weave" function block to enable the swing welding function. As shown in the picture above.

Usually, when the swing welding function is used, it is programmed to add a swing welding function block (Weave) behind the original ArcStart function block. Then in weave, add trajectories that need to be wobbled. All motion instructions added in weave will have a wiggling motion effect until the motion instructions are complete.



The business logic of pendulum welding is to superimpose a layer of periodic and regular swing trajectory on the basis of the original motion trajectory. In the current version, the azimuth is  $0^{\circ}$  by default and cannot be set. As shown in the picture above.

Click the weave feature block to set the weave trajectory. The parameters that can be set are: track type, reference plane, frequency amplitude. When selecting a trapezoidal trajectory, the left and right residence time parameters need to be added.

九边类型	三角 イ	
除考平面	⊥#XOY ✓	
贡率(Hz)	1	
冨值(mm)	1	

Track type:

Support the following types, triangle, sine, arc, trapezoid, 8-word

	We	ave
轨迹类型	三角	~
参考平面	正弦圆弧	
频率(Hz)	梯形 '8'字	
幅值(mm)	1	

Triangular trajectory: Standard swing welding mode. It is usually used in scenarios with large welds and multi-layer welding.



Sinusoidal trajectory: Standard swing welding mode. It is usually used in scenarios with large welds and multi-layer welding.



For a sinusoidal trajectory, the residence time of the left and right endpoints can be set

Arc track: mainly used in lap joints and welding with large caps. The radius of the circle is the same as the amplitude.



Trapezoidal trajectory: Standard swing welding mode. It is usually used in scenarios with large welds and multi-layer welding.



"8" word track: mainly in thick plate welding and surface/exterior grinding, improving strength and other applications.



Reference plane:

With the current tool coordinate system as reference, set the plane where the swing trajectory takes effect. Supports XOY, XOZ, and YOZ planes.


Frequency: The number of cycles performed per second by the swing trajectory.

Amplitude: The boundary of the swing trajectory deviates from the maximum value of the reference trajectory.

Left and right residence time: Used to define the length of the upper and lower sides of a trapezoidal or sinusoidal trajectory.

Left endpoint OP: When swinging to the left end point, the action performed: controls the DO status and duration or triggers the event

Right endpoint OP: Action performed when the swing reaches the right endpoint: controls the DO status and duration or triggers an event

Left to right middle point OP: Action performed when the swing moves from the left endpoint to the right endpoint, passing the intermediate point: controls the DO status and duration or triggers an event

Right to left middle point OP: Action performed when the swing moves from the right endpoint to the left endpoint, passing the intermediate point: controls the DO status and duration or triggers an event

# 3.4 Custom Swing Welding

Welding process package V1.4 and above, DUCO Core v2.9.0 and above Custom swing welding, that is, the user can customize the trajectory of the swing welding In the process file, create a custom swing welding track file and set a custom track point

renium X.H	焊机设置	焊接设置	工艺文件	焊接保持	p #	即们信号	传感器设置			
口の	超强工艺文件	所有文件	新建	据焊自定	Ÿ.					+
4	收强工艺文件	qw	•••	1	X	Y	Z	R	L	
移动	探探机运	we		1	0	0	0			8
<>>				校验和(	0	0	0			
程序				参考平面		工具XC	Y V			
け 第日				左端点停	留时间(ms)	0				
<b>⊟</b> ≉				右端点停	留时间(ms)	0				
ô										₿. Ø
12m										
X										

A maximum of 10 pendulum solder joint positions can be set. Point configuration parameters include X: The direction along the tangent line of the trajectory Y: The direction determined by Z and X cross Z: The direction in the reference plane perpendicular to the tangent line of the trajectory R: indicates whether the endpoint is a right endpoint L: indicates whether the endpoint is a left endpoint When setting, ensure that the sum of each point in the X, Y, and Z directions is 0

Reference plane: Select a plane of the tool coordinate system as the reference plane of the swing Left endpoint residence time: Residence time of the left endpoint

Right endpoint residence time: Residence time of the right endpoint

un XR	焊机设置	焊接设置	工艺文件	焊接	采护 t	早机信号	传感磷设置			
	起弧工艺文件	所有文件	852	据焊白:	定义					+
t.	收弧工艺文件	qw	•••		X	Y	Z	R	L	
₽° E动	探索和政治	we		1	5	2	0			8
Þ				2	-2	-2	0			8
序				3	-3	0	0			8
<b>5</b>				校验和	0	0	0			
3				参考平	dī	工具X	ر. YC			
3				左端点	停留时间(ms)	0				
22				右端点	停留时间(ms)	0				
K 112										9.47

In the Weave block, select the track type as Custom and select the track file.

nium XR	<	weld/weave.jspf*	已打开程序	9356	依親	保存程序
<b>口</b> 概范	1	主程序	指令 章	2	6R	运行
4	2	🕂 Start 🚥		Weav	e	
移动	3	🍫 "Weave 🚥	轨迹类型	自定义	~	
	4	undefined	轨迹文件	选择	we	
\$			標率(Hz)	1		
接口			□左端点OP			
<b>₿</b> ₿			触发操作		~	~
ര			持续时间(ms)	0		
(2) (2)			□右跳点OP			
			触发操作		~	~
X			持续时间(ms)	0		
2474			□左到右中间点OP			
			熱労損作			

You can simulate running trajectories



# 3.5 Arc Tracking

Welding process package V1.4 and above, DUCO Core v2.9.0 and above Arc tracking is mainly used in the welding of thick plate. In the welding process, the current flow between the welding wire and the workpiece is detected to compensate the welding trajectory of the robot.

Only the up and down direction and the left and right direction can be compensated, and the left and right direction can be compensated only in the sine type swing welding.

Arc tracking command: ArcTrack

The configuration parameters are as follows:

Type: Used to set the arc tracking type, with the following options:

End Clear path information. The offset information is cleared when the tracing is complete

End The path information is retained, and the offset information is retained when the tracing ends

Use the recorded path information, use the offset information of the last tracking record to track (mainly used for multi-layer multi-pass welding)

Compensation direction: Select the direction where the compensation function is enabled, Y (left and right direction), Z (up and down direction). You can choose to enable Y and Z compensation for sine pendulum welding, other types can only enable Z compensation

Reference current: reference current value

Ratio coefficient of current height: Ratio coefficient of welding current to welding gun height, default value 4

Maximum compensation distance limit: The maximum allowable deviation distance of the left and right direction and the up and down direction relative to the teaching trajectory

(98)	工程 project_1	②読   工具 工作     Zet ltcp1 Okg   default	JOG % 空间JOG 100%	手动模式 真机 品 と ちちゃく へ
DUCO COROT Premium XM	۲.	weld/arc.jspf*	已打开程序	· · · · · · · · · · · · · · · · · · ·
<b>口</b> 概況	1	主程序	描令	安量 祭教 运行
4	2	🕂 Start 🚥		电弧跟踪
移动	3 🔻		类型	结束清除路径信息 >
	4	undefined	补值方向	OY OZ
\$			基准电流	20
捩口			电流高度比例系数K	4
e			最大补偿距离限制	
			Y751问(mm)	100
© RE			Z方向(mm)	100
X				
2023-05-28 19:11:27				RZIH ANG

# 3.6 Multi-layer Multi-pass Welding

Welding process package V1.4 and above, DUCO Core v2.9.0 and above

The welding of medium and thick plates often requires multiple welding of the same part to increase the welding width. The main principle is: record the track of the first weld and the compensation amount; Based on the recorded amount of compensation, the overall offset is added to achieve subsequent pass operations.

This process package provides a MultipassWeld function block to guide the user through the programming of a multipass welding job.

In the programming page instruction "Extend", look for the "MultipassWeld" function block. Add it to the program, click, the configuration page is as follows

enium XIR	<	weld/multi.jspf	日打开程序 撒纳 恢复 保存者
Q	1 .	主程序	指令 交量 優数 运行
概范	2	4 Start	多层多道焊
	3	(b) MultinassWold	名称 MultipassWeld_1
	,	undefined	在设置/工具设置中标定焊丝末端工具坐标系
租业	4	underined	工具坐研系 请选择
<b>は</b>			\$ 33 AZ
Ö			添加注释
			滞加注释
ଡ ଜଳ			
<b>1</b>			

Configure the tool coordinate system: Use the end of the wire to show the tool coordinate system in the Settings page

Click Parameter configuration to enter the multi-layer and multi-pass welding boot configuration page. It is divided into the following steps, click next or click the navigation menu above to switch.

### Weld configuration

Configure the point position of the initial weld, mainly configure the workpiece coordinate system, the beginning safety point, the starting point, the end point and the end safety point of the weld. It can teach the point coordinates and speed and acceleration of each point.

#L4	L TH 安秋 工具 project_1 爱疑 cmt (	0kg default	0.00% 2000			
BUCO COBOT Presium XH	<b>一</b> 焊盤设置 跟踪	設置	探焊设置	焊線	参数	焊道设置
<b></b>	工具坐标系 Icp1 ~					
参切 2<br 程序	工件坐标系 default ~				速度(mm/s)	加速度(mm2/s)
け 第日	开始安全点 • MultipassWeid_1_safe	P1 示教	记录当前点	移动到此点	100	1000
<b>Ö</b>	■統代(紀己元句) ● MultipassWeld_1_wayi	P1 示款	记录当前点	移动到此点	100	1000
۲	直线(校园) • MultipassWeid_1_way	P2 示教	记录当前点	移动到此点	100	1000
设置	结束安全点 ● MultipassWeld_1_safe	P2 示数	记录当前点	移动到此点	100	1000
0 1381	「 」版 project_1 変換 はcp1 の の の の の の の の の の の の の	Dikg default	JOG 100% 空间JO	G 100%	手动模式	[41] 日本 25 (10) (13) (13) (15) (15) (15) (15) (15) (15) (15) (15
●	工程 project_1 愛装 tcp1 ( 「 「 「 「 「 」 「 」 「 」 に の 」 に の 「 に の 」 に の 「 に の 」 の う に の う の に の う の う の う の う の う の う の	okg default	308 100% 空间300 藤煒设置	g 全局選定 g 100% 焊接	手动模式	UN US 2 5660 4 「「「「」」 「「「」」 「「「」」」 「「」」 「「」」 「」」 「」」
● 待机 XCC0 COOOT Preniue 331 ↓ 載范 ↓ 移动 40 図序	I程 project_1 愛報 Lcp1 ( 「 「 「 「 「 「 「 「 「 」 「 」 「 」 「 」 「 」 「	Okg default	JOG 100% 空间JO 接焊设置	G 100%	手动模式 算 参数 速度(mm/s)	(机) 部語 ご 空金校設 55600 (13) 第道设置
● 待机 DUCCO CODOT Prenium BAT 単 税売 くひ 税売 くひ 規□	工程 project_1     安秋 正理 望疑 比p1     工程 取算 取算       工程坐标系     Lcp1       工作坐标系     default       开始安全点     MultipassWeld_1_safe	okg default t设置 P1 示数	300 100% 空间30 標準设置 记录当前点	G 全局建筑 G 100% 焊接 移动到此点	手动模式 算数 速度(mm/s)	<ul> <li>(机) (13) (23) (25) (25)</li> <li>(月) (25) (25)</li> <li>(月) (25) (25)</li> <li>(月) (25) (25)</li> <li>(1000)</li> </ul>
● 待机 3UCO COODT Previoue 3AN 単 税売 名か 名か 名か 名か 名か 日本	工程 project_1     安装 tcp1       課題     tcp1       課題設置     課題       工具坐标系     tcp1       工件坐标系     default       开始安全点     MultipassWeld_1_safe       直线(起现点)     MultipassWeld_1_way	Dikg 工作 default Fi设置 P1 示数 P1 示数	306 100% 空间30	G 全局速度 G 100% 焊線 移动到此点 移动到此点	手动模式 算数 運度(mm/s) 100 100	
		正律           Okg         正律           default           設置           P1         示数           P1         示数           P2         示数	100% 空间JOG 100% 空间JO 探焊设置	<ul> <li>G 金剛速度 100%</li> <li>第 助到此点</li> <li>移 动到此点</li> <li>移 动到此点</li> </ul>	手計模式 源度(mm/s) 100 100 30	EN 世部 と 空全校社 5500 (13) 第一部の目前の目前の目前の目前の目前の目前の目前の目前の目前の目前の目前の目前の目前の
<ul> <li>● 得机</li> <li>OUCCO COODT Previoue 351</li> <li>● 現 一 現 一 現 一 現 一 日 志</li> <li>● 日 志</li> <li>● 設置</li> </ul>	工程       安秋       工程         資源       tcp1       (1)         資源       現時       (1)         資源       (1)       (1)         資源       (1)       (1)         工作坐标系       (cp1 ~)       (1)         工作坐标系       (cp1 ~)       (1)         开始安全点       MultipassWeld_1_safe       (1)         直线(松30)       MultipassWeld_1_way       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)         「       (1)       (1)       (1)	工作 default           RQ         示数           P1         示数           P1         示数           P2         示数	100% 室间300 100% 室间300 課律设置 记录当前点 记录当前点 记录当前点	G 全国建筑 G 100% 焊接 移动到此点 移动到此点 移动到此点 移动到此点	手計模式 算数 変変(mm/s) 100 100 30 100	<ul> <li>(別 23 と 26bc</li> <li>(別 23 と 26bc</li> <li>(別 256bc</li> <li>(別 2/5)</li> <li>(1000</li> <li>(1000</li> <li>(1000</li> <li>(1000</li> <li>(1000</li> </ul>
● 得机 CUCCO COMOT Premium RAN	工程       安美       工程         評価設置       服装         工具坐标系       Lcp1         工件坐标系       default         开始安全点       MultipassWeld_1_safe         直线(松动)       MultipassWeld_1_wayi         直线(松动)       MultipassWeld_1_wayi         国鉄(松动)       MultipassWeld_1_safe	Dkg     工作       Dkg     default       P1     示数       P1     示数       P2     示数       P2     示数	306 100% 空间300 探煒设置 记录当前点 记录当前点 记录当前点	<ul> <li>G 金剛速度 100%</li> <li>第初到此点</li> <li>移动到此点</li> <li>移动到此点</li> <li>移动到此点</li> <li>移动到此点</li> <li>移动到此点</li> </ul>	手計模式 事業 構築 変(mm/s) 100 100 30 100	EN US 定金校設 5500 ( 定道没置)       加速度(mm2/s)       1000       1000       1000
<ul> <li>● 得机</li> <li>OXCO COMOT</li> <li>Previous RA</li> <li>● 現</li> <li>● 見志</li> <li>● 説</li> <li>● 読</li> <li>● 読<th></th><th>Dkg     工作 default       Black     Gefault       Fig     示数       P1     示数       P2     示数       P2     示数</th><th>100% 室间100 第2章没置 (記录当前点 记录当前点 记录当前点 记录当前点</th><th>G 全国建筑 G 100% 煤線 移动到此点 移动到此点 移动到此点 移动到此点</th><th>手計模式 事業 参数 部数 100 100 100 100 100 100</th><th>こまた、   とれていた。   こまた、   たいに思想(mm2/s)   1000   1000    1000    1000</th></li></ul>		Dkg     工作 default       Black     Gefault       Fig     示数       P1     示数       P2     示数       P2     示数	100% 室间100 第2章没置 (記录当前点 记录当前点 记录当前点 记录当前点	G 全国建筑 G 100% 煤線 移动到此点 移动到此点 移动到此点 移动到此点	手計模式 事業 参数 部数 100 100 100 100 100 100	こまた、   とれていた。   こまた、   たいに思想(mm2/s)   1000   1000    1000    1000

### **Tracking Settings**

Configure whether the weld uses tracking, you can choose not to use tracking, use arc tracking, use laser tracking. When selecting arc tracking, see Section 5.4 "Arc Tracking" for configuration parameters, and Section 7.7 "Laser Tracking" for configuration parameters.

(98)	工程 project_1	安統 工具 工件 変装 tcp1 0kg defaul	JOG 100% 空间JOG	金用速度 100% 手动模式	現れ Him ア 安全校社 へ
DUCO COBOT Presium 3/H	•		•	•	•
ロの	焊缝设置	跟踪设置	接焊设置	焊接参数	焊道设置
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9 (BIL	project_1	安秋 工具 工 逐获 tcp1 0kg defa	# JOG wit 100% 空间JOG	全局速度 100% 手动模式	真机 L3 2 56bc
BUCO COBOT Presiden XR	焊缝设置	in at 10 m	接焊设置	焊接参数	焊道设置
◆ 移动 \$ 20 20 20 20 20 20 20 20 20 20 20 20 20	顕即方式	不使用跟踪 〈 不使用跟踪 电弧跟踪 激光跟踪			
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( <b>9</b> 131)	1.5%	308 14 14	£ 300	12 10 (W TP)	10000 ( M) 00-0-0000
	project_1	亚装 tcp1 0kg defa	uit 100% 空间JOG	100% 手动模式	與机 L3 图 560c 个
DUCO COBOT Prenius 331	project_1 焊缝设置	菱硬 tcp1 0kg defa	uit 100% 空间JOG	100% 手动模式	其机 L3 上 560c ▲
DUCC COBOT Prenium X.R 版范	project_1 焊缝设置 跟踪方式	遊技 tcp1 0kg defa ■ 副称i0 置 激光跟踪 ~	uit 100% 空间JOG 按焊设置	100% 手动模式	真机 L3 2 56bc A
DUCO COBOT Prentum XH 概范 登动	project_1 焊缝设置 跟踪方式 焊缝模式参数	選接 tcp1 0kg defa 副時设置 創た原意 ~ 1	uit 100% 空间JOG 按焊设置	100% 手动模式	真机 L3 L S6bc A
DUCC COBOT Prentum XR 概范 ◆ 移动 程序	project_1 焊缝设置 跟踪方式 焊缝模式参数 补值方向	<ul> <li>         ま装 tcp1 0kg defa         </li> <li>         訳除記録         </li> <li>         Y Z         </li> </ul>	uit 100% 空间JoG	100% 手动模式	其机 L3 L SGOC A
DUCCO COBOT Presium X31 口 概況 登功 程序 【1 接口	project_1 焊缝设置 跟踪方式 焊缝模式参数 补值方向 提前距离	変装 tcp1 0kg defa   副計算数 / 2 / 2 / 2 / 2 / 2 / 2 / 2 / 2 / 2 /	uit 100% 空间JOG	100% 手动模式	真机 L3 L Sobc A 焊道设置
DICCO COBOT Prenture X31 中 概況 登 彩动 なみ 授序 社 接口 日 日	project_1 焊缝设置 跟踪方式 焊缝模式参数 补信方向 提前距离 最大补偿距离限制 又实现(mm)	変要では、「たない」のは、「たない」のは、「たない」では、「たない」では、「たない」では、「たいでは、「たい」では、「れい」では、「は、「れい」では、「は、「れい」では、「は、「れい」では、「れい」では、「れい」では、「は、「れい」では、「は、「は、「は、「は、「は、「は、「は、「は、「は、「は、「は、「は、」、「は、「は、「は、「は、「は、「は、」、「は、「は、「は、「は、」、「は、「は、「は、「は、」、「は、「は、「は、」、「は、「は、「は、「は、「は、「は、「は、「は、「は、」、「は、「は、「は、」、「は、「は、」、「は、「は、「は、」、「は、「は、「は、」、「は、「は、」、「は、「は、「は、」、「は、「は、「は、」、「は、「は、」、「は、「は、」、「は、「は、「は、」、「は、「は、」、「は、「は、「は、」、「は、」、「は、」、「は、「は、」、「は、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、」、「は、」、」、」、「は、」、」、「は、」、」、「は、」、」、「は、」、」、」、「は、」、」、」、「は、」、」、」、」	uit 100% 空间JOG	100% 手动模式	真机 L3 L Sobc A 焊道设置
DUCCO CODIOT Premium XR 中 概范 中 形 形 社 規口 日志	project_1 焊缝设置 跟踪方式 焊缝模式参数 补值方向 提前距离 最大补偿距离限制 Y方向(mm)	変要では、   またのでは、   またのでは、 </th <th>uit 100% 空间JoG</th> <th>100% 手动模式 焊接参数</th> <th>其机 比3 定道设置</th>	uit 100% 空间JoG	100% 手动模式 焊接参数	其机 比3 定道设置
DUCO CODOT Pressue XR Pressue XR 概范 争 移动 化 投序 化 規回 日志 (公置	project_1 焊缝设置 跟踪方式 焊缝模式参数 补信方向 提前距离 最大补偿距离限制 Y方向(mm) Z方向(mm)	正式の目前では、「「「「」」」では、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、	uit 100% 空间JOG	100% 手动模式 焊接参数	其机 L3 定道设置
DUCCO CODOT Prentum X31 中 概況 中 彩助 275 275 275 275 275 275 275 275	project_1 焊缝设置 跟踪方式 焊缝模式参数 补信方向 提前距离 最大补偿距离限制 Y方向(mm) Z方向(mm)	正式の目前には、「「「」」」では、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、	uit 100% 空间JOG	100% 手动模式 焊接参数	其机 比 定 提 提 记 定 一
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### Swing welding Settings

Select whether to enable swing welding and set the type, reference plane, frequency, amplitude, OP, etc. For details about the configuration parameters, see Section 5.3 "Swing Welding".

() 1361	工程 project_1 安装 要装	工具 工作 tcp1 0kg defau	J00 100% 空间JOG	全局进程 100% 手动模式	風机 出潮 L3 と 56bc へ
DUCO COBOT Presiue XR	•	•		•	
	焊缝设置	跟踪设置	摆焊设置	焊接参数	焊道设置
⊕	启用 0	FF			
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(34)	工程 project_1	安終 工具 靈装 tcp1 0kg	工作 default 100% 空间JOG	金馬速度 100% 手动模式	貫机 L3 ピア 566c へ
Prenium XIN	焊缝设置	調許设置	<b>医</b> 按照设置	探浪参数	焊道设置
概范	启用	ON			
移动	轨边关型	三角 ~			
粗水	参考平面	IRXOY ~			
お 第日	版率(Hz)	1			
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<b>ଡ</b> ଜଞ୍ଚ	<ul> <li></li></ul>	D01 v 0			
x	持续时间(ms)				
35,12	<b>般</b> 发操作	D01 V 0	~		
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### Welding parameters

Set welding parameters, such as welding current, voltage, and JOB number. For details about the configuration parameters, see section 5.2 "Arc Starting/Closing Function Block" .

1340.	project_1	安装 工具 工作 登装 tcp1 0kg defa	JOG 全形活躍 100% 空闲JOG 100%	手动模式	真机 L3 2 56bc
Prenium 3/1	•	•	•	$\bigcirc$	•
0	焊缝设置	跟踪设置	探焊设置	焊接参数	焊道设置
	起郑参数		收弧参数		
移动	选择起现工艺文件	1212	□ 选择收到工艺文件	选择	
20 8 20 8 20 8 20 8 20 8 20 8 20 8 20	焊接电流(A)	0	焊接电流(A)	0	
け <sup>捩口</sup>	焊接电压(V)	0	焊接电压(V)	0	
<b>⊟</b> ≋	Job号		Job号		
٢	设置空韵信率				
设置	倍率(1-10)	5			
X					
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### **Bead setting**

Configure the offset, indent, tool posture, etc., for each subsequent pass, up to 9 passes can be added.

The parameters of the bead are:

Y offset: Y of the tool coordinate system

Z shift:

Tool-ry: indicates the rotation in the Y direction of the Tool reference coordinate system

Tool-rz: The rotation in the Z direction of the Tool reference coordinate system

Path-rx: The rotation of the Path tangent at the start of the tool' s reference path coordinate system (for a straight line, the rotation in the direction of the reference path)

Start indent: The distance from the start of the weld to the path direction

End indent: The distance by which the end of the weld is indent along the path direction



The default swing welding parameters and welding parameters of each weld pass are the same as those of the initial weld. Individual pass parameters can be set individually by clicking the Edit button

RSHI	pro		臺號 tcp1	Okg defau	n 100% s	ยสมog 10	- 手动模 	<u>عام</u> ر الم	3 K 56bc
<b>口</b> 概范		焊缝设置	15	膝设置	掃煙设	蓋	焊接参数	1	理論设置
	G	$\mathcal{H}$	29426429	201					
<b>\$</b> ⊮□	序号	Y偏移	Z值移	Tool-RY	Tool-RZ	Path-RX	起点道进	终点继进	
<b>⊟</b> ≉	1	10	10	0	0	0	0	0	6 8
<b>()</b>	3	-10	10	0	0	0	0	0	6 8
									_
								退出引	守 完成

Bead detailed configuration

LOI I	焊道设置-均	<u>1道</u> 2					
	偏移量				影踪设置		
	Y编移(mm)	10	Tool-RY(")	0	跟踪方式	激光跟踪 ~	
	Z偏移(mm)	10	Tool-RZ(")	0	焊缝模式参数	1	
	起標識进 (mm)	0	Path-RX(*)	0	料信方向	Y Z	
	终点::::::::::::::::::::::::::::::::::::	0			提前距离	0	
	运动参数				最大补偿距离限制		
	焊接速度(mm/	(s) 30			Y方向(mm)	100	
	焊接加速度(mr	m/s2) 1000	)		Z)方向(mm)	100	
	摆焊设置				起调整数		
	启用	ON			□ 选择起强工艺文件	选择	
	時にために用い	=0			焊接电流(A)	0	

After the configuration is complete, click OK to automatically generate the program block. Note: The generated block cannot edit the parameters separately, if you need to change the parameters, please set them in the parameter configuration of the MultipassWeld block.



# WELDING TROUBLESHOOTING

In the welding process, according to the source of the fault, it can usually be divided into three fault modes, welding machine fault, communication fault, robot fault. This chapter describes three troubleshooting methods and how to restart the arc after the fault is rectified.

## 4.1 Welding Machine Failure

When an error occurs due to the welder, the welder will send the welder error id to the robot. The error id can be queried under the welder signal page. If the signal is configured with the corresponding register, the information can be obtained by reading the register through the external communication interface of the robot. After the failure:

On the side of the welder, the arc closure action will be performed automatically.

On the robot side, the program will be suspended after receiving an error message from the welder.

### 4.2 Communication Failure

During use, if the communication is affected, the CAN communication between the welding machine is interrupted:

At the welder side, communication interruption will be detected within 1 second, communication error will be reported, and automatic arc closure action will be performed.

On the robot side, a communication interruption is detected within 3 seconds, a communication error is reported, and the program is suspended.

### 4.3 Robot Malfunctions

When an error occurs due to the robot, the robot will send a robot fault signal to the welder.

On the side of the welder, after receiving the error signal from the robot, the welder will automatically perform the arc closure action.

On the robot side, when the robot reports an error, the program will be paused.

# 4.4 Re-arc

After a fault occurs, the robot program pauses and automatically records the current pause point information. At this time, the robot is allowed to move away from the current point in a manual jog, which is convenient for the user to troubleshoot.

When the fault is rectified, clicking the program to run again will ask the user to return to the pause point first. The way to return to the pause point is movej. As shown in the picture below:



Press and hold the "Press and move" button, the robot moves in the way of movej, and the movement stops when you release it. To prevent the movej from bumping into other objects in its path, it is recommended that the user return to the pause point in advance in a manual jog.

After returning to the pause point, switch the robot to automatic mode, click continue to run the program, the robot will send the arc starting command to the welder, and continue to execute the subsequent program after the arc is successfully started.

# CHAPTER

# LASER TRACKER

# 5.1 Introduce

The laser tracker acquires the characteristics of the weld and identifies the weld by collecting the laser image. The robot acquires the characteristic information it recognizes and realizes the automatic monitoring and correction of the weld. In practical application, it can solve the problems such as the placement error of the workpiece, the poor consistency of the workpiece, and the deformation of the weld caused by welding heat.

The welding process package supports laser locating and laser tracking.

# 5.2 Laser Communication Connection

Use a network cable to connect the network port on the robot control cabinet to the laser sensor, and configure the IP address of the robot and the laser sensor to the same network segment. Enter the IP and port number of the laser sensor and click Connect. After the connection is successful, the connection status is displayed. The connection Settings for each manufacturer are as follows

Beijing Creation:

It is necessary to set the laser protocol to Modbus by using the upper computer of the Idea first. Connect to port 502

Tangshan Yinglai:

Set the port number to 5020.

Suzhou Total Vision:

Set the port number to 502

Laser sensor control

You can manually operate the laser sensor, turn the laser on/off, and obtain the data detected by the laser.

niun ER	焊机设置	焊接设置 工艺文件	焊接保护 焊机信号 传感器设置
<b>口</b> 航池	传感器连接状	æ 🔵	传感器标定
	传感器设置		查看标定參数 标定传感器
	传感贛品牌	北京创想、	
星序	IP她址	192.168.2.3	
<b>は</b>	第日	502	
<b>⊟</b> ≉	传感器操作	86 <del>77</del>	
٥	打开激光	关闭激光 使能 断使能	
22	获取数据		
1.14	焊缝 无效 左右偏移(mm) 焊缝宽度(mm) 当前参数 1	0 上下偏移(mm) 0 0 焊缝深度(mm) 0	

# 5.3 Laser Calibration

The calibration of the laser sensor is used to calculate the position relationship between the robot TCP and the sensor. That is, according to the results of calibration calculation, the feature points identified by the laser can be converted to their pose in the robot coordinate system.

Calibration preparation:

1. Install the welding gun and adjust the length of the welding wire to the length used in the welding process

2, Install the laser sensor according to the installation requirements of the laser sensor and the site situation

3. Prepare to calibrate the sharp points used by the robot TCP

4, prepare the switch and other network equipment to connect the laser sensor, the upper computer used by the laser sensor, the robot, and set them in the same network segment to ensure normal communication

5, make sure that the laser image can be seen on the upper computer of the laser sensor

6. Verify that the laser switch and data acquisition can work normally in the sensor setting page of the robot welding process package

Calibration process:

1, the tool (TCP) calibration, that is, the calibration of the end position of the wire, the length of the wire is the length of the actual welding wire. The calibration method is as follows:

In the robot' s Settings page - Tool Settings, create a TCP, according to the 4 point calibration method or 6 point calibration method

	IRGS	1426	K 1	<b>杂研究置</b>	文堂公園	安全市	275	Kitters	NORE	1019-02
I	Resis					1830	Å	5 1	0	80
69.5	8.6	6278	11.02	86	19/1					- 40
1	default	0,0,0,0,0,0	0	0,0,0	•••	814			1	
2	top1	50,20,100, 0,0,0	0	0,0,0	•••		0			
3	top2	0.20,0,45, 0,0	0	0,0,0	•••		Θ		•	r
							A	77		
							7	//	1	11
17										
17								>		
17	weld		)	тс	P4632			>		
17 1坐标系 m)	weld		)	TC:	PHődž			,		
17 建全标系 m)	weld 0		)	TC: RX(") RY(")	PHEAR			,		
17 見坐标系 m) m)	weld 0 0		))))))	TC: RX(*) RY(*) RZ(*)				×		
17 1坐标系 m) m)	weld 0 0		) )	TC: RX(") RY(") RZ(")	PARAR 0 0 0					
17 1坐标系 m) m)	weld 0 0		) ) )	TC: RX(") RY(") RZ(")		· · ·		, 		
17 117 (kg) m)	weld 0 0 0 0 0		)))))))))))))))))))))))))))))))))))))))	TC: RX(") RY(") RZ(") X	P46d2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	米里に開	z	×		
17 12 11 11 11 11 11 11 11 11 11 11 11 11	weld 0 0 0		) ) ) ) x	TC: RX(") RZ(") RZ(") X 0			Z O			
n7 17 (kg) m) m) m)	weld 0 0 0		) ) ) ) x	TC: RX(") RZ(") RZ(") X 0	P45:32 0 0 0 0 0 0 0 0 0	*皇纪元	Z 0 0	,		

选择标定种类		×	
标遗种类:	<b>0</b> 4/2005/2010	6128532	
		BOH MAR	)
4点标定		*	
请输入工具	姿态后単击下一歩	:	
RX(")	0		
RY(")	0		
RZ(*)	0		
		下一步	

The mobile robot aligns the end of the wire to the cusp point and records the four points respectively

4点标定		*
移动到第一个点	<b>说题</b> P1	•
移动到第二个点	<b>设置</b> P2	•
移动到第三个点	i22093	•
移动到第四个点	设置P4	•
		構定

Click OK to calculate the calibrated TCP coordinates and errors. Control the average error and maximum error within 0.5mm.

Set the calibrated TCP to the current TCP

2. Take a mark point on the weld, move the robot, align its TCP with the mark point, and click Record

	中操丝的长度) REZ焊枪出丝长
	中焊丝的长度) RE焊枪出丝长
	中爆丝的长度) 管压焊枪出丝长
#30     IP地址     192.168.2.3     度不交     項不交     項の     項の     項の     項の     項の     「     」     」     」     」     」     」     」     」     」     」     」     』      』	
	280-0
使感轉操作 焊缝上取一个标记点,控制机器人TCP对准标	6004-940
	3点 记录
打开激光 关闭激光 使能 断使能 新使能 别记录六个点	目标记点上,分
3志 点1	记录
Ø #2	记录
22 焊缝 无效 左右编移(mm) 0 上下编移(mm) 0	记录
焊缝宽度(mm) 0 焊缝深度(mm) 0 /#4	记录
当約參数 1	记录
46.	

3, Keep the posture of the robot unchanged, turn on the laser, turn on the enable, move the robot, let the laser fall on the marking point, observe the laser image on the laser software during the marking process, and make the laser image into the six states in the following figure respectively, and record the points 1-6



4, click calibration calculation, calibration error and calculation results will be displayed below. If each value is less than 1mm, calibration is valid, otherwise re-calibration.

- 御社 -		(111)
C AA		
N.82		
-0.4444323076	0.4731866994	0.1261129967
2 -0.6216063899	0.0335949557	0.3903444875
3 0.0710442612	0.5763432007	0.3245066480
4 0.4488599051	-0.1407749323	-0.3473909727
5 -0.4799958360	-0.1894699238	-0.0497320050
6 0.5021109595	-0.5026444377	0.0468752638
2007	C.	E
-0.2577007483	-0.9267737109	-0.2732779045
-0.6112166018	0.3754112681	-0.6967644117
0.7483345442	-0.0125247161	-0.6632032429
136.05		at the providence of
-153.3788631836		
-55.9984362333		
-97.0575411966		
WANDOWS THE		Malla Salatsala

5. Click Save the calibration result, and the calculation result will be saved after confirmation. Note: The calculation result is stored in the current project of the robot. It is recommended to save the project at this time to prevent loss.

Attention:

- 1. Robot TCP needs to be calibrated before calibration to ensure calibration accuracy
- 2. Before calibration, set the calibrated tool coordinate system to the current

3. When recording 7 points, the length of the welding wire is consistent with the calibration TCP, and the length of the welding wire should also be consistent with the welding process

- 4. When recording 7 points, the posture of the robot cannot be changed
- 5. When recording these 7 points, ensure the stability of laser image detection

Calibration accuracy verification

After the sensor and robot are calibrated, the accuracy of the calibration can be verified using a single point of search. Write the following program using the function blocks LaserSearchPose and MoveL. LaserSearchPose will turn on and enable the laser, obtain the feature point information recognized by the laser, convert it into its value under the robot base marker system, and assign the value to the variable. MoveL moves to this variable. Run the program to check whether the robot TCP has moved to the identified feature points.

Note: Please ensure that the TCP used at this time is the TCP used in the above calibration

<b>9</b> 8987	III pro2	登録 Weld5 Okg II中 default	□ 100% 手动機式 真机 品牌 2 2200k (8c3
Pusio collet Presiue ER	<	laser/search.jspf	已打开程序 撒纳 恢复 保存程序
Q	1 -	主程序	(M)令 支量 参数 运行
5238 44	2	🕂 Start …	+ Move
移动	3	LaserSearchPose ····	2010年2月1日 移动
*/* 程序	5	Move ····	↔ MoveJ 器程
<b>\$</b>	6	🕂 Movel. ppp \cdots	
<b>8</b>			IN THE REFERENCE OF THE
٢			◆ MoveC 通讯
W.M.			日期日本の
X			MoveTCP
100			+ Spline

# 5.4 Programming Function Block

There are three functional blocks related to laser sensors: LaserSerachPose, LaserSearchOffset, LaserTrack.

### LaserSearchPose

It is mainly used to obtain the pose of the feature points identified by laser in the robot base coordinate system. The function block encapsulates the following operations: select the Job number used, turn on and enable the laser, obtain the feature point position information recognized by the laser, obtain the current TCP value of the robot in the base coordinate system, calculate the pose information of the feature point in the base coordinate system. The robot relationship, and assign the pose type variable. If no weld is detected, return nil The configuration page is as follows

### 获取寻位点

6标系下,关闭激光。1	未识别到焊缝时,	返回nil
焊缝模式参数(Job)	1	
寻位点		~
焊缝持征点偏移(传感器	(坐标系)	
Y方向(mm)	0	
Z方向(mm)	0	

Weld mode parameter: that is, Job number, is a set of parameters set and saved at the end of the laser tracker: such as weld type, exposure, detection capability, etc.

Location-seeking: The result of a calculation that can be associated with a pose type variable

Weld feature point offset: Add the offset to the identified feature point and calculate the pose after the conversion of the offset point. It can be used to deal with problems such as robot error, detection point and welding process mismatch (if the laser tracker provides the function, it can also be set at the laser tracker end)

#### LaserSearchOffset

It is mainly used to calculate the pose of the coordinate system obtained by three or four point positioning

The configuration page is as follows

#### 计算坐标系

计算方法	三点寻位	~
选择点位		1
PI	P2	P3
P1	p1	v
P2	p2	v
P3	p3	•
结果	teach_pos	~

The following Settings are available

Calculation method: Choose three-point or four-point search

Select point: Associates point information

Result: The calculated result, associated with the pose type variable

### LaserTrack

Realize laser tracking function.

Main functions: turn on and enable the laser, set the Job number used by the laser, set the compensation direction and advance distance, obtain the weld feature points in real time, calculate the deviation and compensate to the actual trajectory.

The configuration page is as follows

### 激光跟踪

焊缝模式参数(Job)	2
补偿方向	<b>Z</b> Y□Z
提前距离(mm)	0
最大补信距离限制	
Y方向(mm)	100
Z方向(mm)	100
结束关闭跟踪	
焊缝特征点偏移(传感器	¥坐标系)
Y方向(mm)	0

The following Settings are available

Weld mode parameter: Job number

Compensation direction: Select Y or Z direction to enable compensation

Advance distance: Set the distance between the laser wire and the welding torch, in mm.

Maximum compensation distance limit: The maximum allowable deviation between the taught trajectory and the trajectory measured by the laser

Weld feature point offset: The offset is added to the identified feature point (if the laser tracker provides the function, it can also be set at the laser tracker end)

# 5.5 Programming Scripts

The following script is added to the welding process package, which can be invoked when programming with the script

Turn on the laser

\_plugin\_weld.open\_laser()

Laser off

\_plugin\_weld.close\_laser()

Enable laser (Creative laser sensor needs to be called)

\_plugin\_weld.enable\_laser()

Lower enable laser (Creative laser sensor needs to be called)

\_plugin\_weld.disable\_laser()

Set weld type parameters (Job number)

\_plugin\_weld.set\_laser\_weld\_type(type)

Position seeking, the function is the same as LaserSearchPose function block, turn on the laser, obtain the weld feature point, calculate its position and pose in the robot coordinate system, and turn off the laser.

\_plugin\_weld.search\_pose(pose, offset)

pose: pose type, robot TCP pose, unit m, rad

offset: specifies the number\_list offset of the weld feature points. The value is  $\{y, z\}$ . The default value is  $\{0, 0\}$ , in mm

Returned value

pose type: pose of the feature point in the robot coordinate system. When the unit m, rad, is nil, it means that no weld is detected

Similar to search\_pose, the laser is not switched on and off, the weld feature points are obtained, and the pose in the robot coordinate system is calculated

\_plugin\_weld. get\_laser\_search\_pose(pose, offset)

pose: pose type, robot TCP pose, unit m, rad

offset: specifies the number\_list offset of the weld feature points. The value is  $\{y, z\}$ . The default value is  $\{0, 0\}$ , in mm

Returned value pose type: pose of the feature point in the robot coordinate system. When the unit m, rad, is nil, it means that no weld is detected

Obtain raw laser data

\_plugin\_weld.get\_laser\_raw\_data()

Return the following array {status, y, z, width, depth}, respectively

status: boolean Indicates whether a weld is detected

y: number indicates the y-direction coordinate of the weld feature point (unit: mm)

z: number indicates the z-direction coordinate of the weld feature point, in mm

width: number, the width of the detected weld, in mm

depth: number: depth of the detected weld (unit: mm)

# 5.6 Laser Locating

Single point search

Suitable for spot welding and other scenarios

A programming example is as follows:

() ISU	III pro2	空間 工具 工具 工具 工件 透镜 weld5 Ckg default	100% 手动振动 真机 品牌 ア 2210社 人
DUCO CONST Presiue 328	<	laser/search.jspf	已打开程序 撤销 恢复 保存程序
Q	1 .	主程序	指令 支量 参数 运行
#535	2	💠 Start	🕂 Move 🕀
移动	3	↓ LaserSearchPose ···	运动制令交货点 移动 99
10#	5	Move ····	MoveJ     医联节移动
10 10	6	🔶 MoveL ppp \cdots	Movel.     認識控制
<b>⊟</b> ≋			to the total and
() ()			MoveC
			高级
X			*38世经动 <b>扩展</b>
时间 10:42:45			🕂 Spline

Two-point search

Suitable for intermittent short welding and other scenarios



Programming example is as follows

未使能		工程 pro2	会装 遊装 weld5.	IR Itt default	道度 100%	手动模式	真机 L3 (	ア 安全校論 C8c3
DUCO CORDT Presider 3/1	<		laser/tw	o.jspf	日打开	程序 撤销	依复	保存程序
Q	1		主程序		指令	交量	伊政	运行
概范 ◆	2	"anne"	🕂 Start	•••	<b>.</b>	Move		•
移动	3		Move     LaserSearchPose		运动用令交节点			移动
<u>程</u> 序	6	•	+ Move		◆ 按关节移动	MoveJ		25.6H
設立	8		LaserSearchPose	,	+	MoveL		にたいまた。
日志	9		Move  MoveL pp1		10.0010.0010			18.17
<b>ම</b> ලක	11		MoveL pp2		+ 107700/#30	MoveC		3
					<b></b>	MoveTCP		高级
X X					末調還量移动			扩展
时间 17:05:49					+	Spline		

Three-point search/four-point search

The basic principle is: a workpiece coordinate system is established according to the point position of laser locating, and the deviation between it and the original workpiece coordinate system is calculated, so as to obtain the offset of the weld on the workpiece. It can be used for welding of complex structural parts. Compared with three-point locating, four-point locating can better deal with the incoming material error and assembly error of the workpiece.





The following is a Demo of three-point search, four-point search is similar to three-point search.



Variable definition

Vari- able name	type	
P1	pose	The first search site obtained
P2	pose	The second seek site obtained
P3	pose	The third search site obtained
teach_po	pose	The result of three point search calculation
g_enable	boole	Control program operation. When false, it is used to calculate the initial workpiece coordinate system for the first search; If the value is true, the normal job process is performed
g_base_r	pose	Calculated initial workpiece coordinate system
g_pose	pose	The result of three search calculations
g_offset	pose	Deviation from the initial coordinate system

Program specification

The first search point in line 3

Line 5 search, get the search result, save in variable p1

Line 6 second search point

Search for 8 lines, obtain the search result, and save it in variable p2

Line 9 third search site

Search in line 11 to obtain the search result and save it in variable p3

12 lines of three-point search, calculate p1,p2,p3 determined coordinate system, save in variable teach\_pose

If g\_enable\_offse is false, assign the teach\_pose value to g\_base\_pose. Otherwise, the value is assigned to the variable g\_pose

Line 17 Perform subsequent operations when g\_enable\_offset is set to true

The script in line 18 uses pose\_offset() to calculate the coordinate deviation of g\_base\_pose and g\_pose and assigns the result to the variable g\_offset

Line 20 adds g\_offset as a coordinate offset to the current coordinate system

21-24 lines of actual work points, using the workpiece coordinate system.

The actual use process is as follows: 1, teach the robot, determine the laser search point

2. Set the workpiece, set g\_enable\_offset to false, and run the program

3. View the value of g\_base\_pose in the variables area and create a new workpiece coordinate system wobj1, which uses the value of g\_base\_pose

4. Set wobj1 as the current workpiece coordinate system, and use this coordinate system as the reference to show the work track of the teaching workpiece, that is, the point position of lines 22-24

5. Set g\_enable\_offset to true, run the program, and execute the normal job flow.

The above Demo uses the workpiece coordinate system, and obtains an initial workpiece coordinate system by performing the three-point search calculation for the first time, based on which the teaching operation point is shown. Ensure that if the workpiece has a certain deviation due to placement, you can calculate the deviation of the coordinate system obtained by three-point positioning and the initial coordinate system, and add the deviation to the workpiece coordinate system, so that the operation trajectory can adapt to the change.

Because the Demo needs to set the coordinate system of the workpiece, in some cases, the teaching needs to change the coordinate system frequently, which may be complicated. You can refer to the following Demo, using the RecordPoseTrans function block, you can be based on the base coordinate system programming.



Variable definition
Vari- able name	type	
P1	pose	The first search site obtained
P2	pose	The second seek site obtained
P3	pose	The third search site obtained
teach_po	pose	The result of three point search calculation
g_enable	boole	Control program operation. When false, it is used to calculate the initial workpiece coordinate system for the first search; If the value is true, the normal job process is performed
g_base_p	pose	Coordinate system for three-point homing calculation
g_result_	pose_	The pose of the actual operation point in the base coordinate system
g_way_p	pose	The first operation point
g_way_p	pose	Second operation point
g_way_p	pose	The third operation point
g_way_p	pose	The fourth operation point

Program specification

The first search point in line 3

Line 5 search, get the search result, save in variable p1

Line 6 second search point

Search for 8 lines, obtain the search result, and save it in variable p2

Line 9 third search site

Search in line 11 to obtain the search result and save it in variable p3

12 lines of three-point search, calculate p1,p2,p3 determined coordinate system, save in variable teach\_pose

Line 13 assigns the teach\_pose value to g\_pose

Line 14 Perform subsequent operations when g\_enable\_offset is set to true

15 lines of action point to teach the transformation and save the results in the variable g\_result\_list

Lines 16-19 get the points from the g\_result\_list and assign them to the job point variables

Lines 20-24 perform the actual job, the point using the individual job point variables

The actual use process is as follows:

1, teach the robot, determine the laser search point

2. Set the workpiece, set g\_enable\_offset to false, and run the program

3、Check the value of g\_base\_pose in the variable area and open the RecordPoseTrans function block, as shown in the figure. Select variable g\_base\_pose from the input reference pose and click the "Set as baseline" button, the baseline pose value is displayed on the baseline pose.

g_base	por V	设置为基准				
基性位姿			[	-856.6, 5	380.33, 94.39	9, 2.74, 0.43, 48.35
攝作点價	置					示教研究和
X	Y	Z	RX	RY	RZ	
-862.97	538.46	97.24	-144.09	8.1	66.14	1
-856.5	593.66	98.23	-144.09	8.1	66.14	<b>1</b>
-853.94	593.65	96.97	-144.09	8.1	44.14	1
810.43	632 59	97.76	-144.09	81	44.14	<b>a</b>

4. In the operation point bias, teach to add job points, and select a pose\_list variable in the output to store the calculated job points results

5. Set g\_enable\_offset to true, run the program, and execute the normal job flow.

Compared with the previous Demo, the variables are used as the actual job points, and the points are calculated through RecordPoseTrans. Use the coordinate system obtained for the first time as the benchmark to teach each job point and add it to the RecordPoseTrans block. Subsequently, if the workpiece is offset, the RecordPoseTrans function block is used to calculate the value of each operation point in the base coordinate system according to the coordinate system calculated by searching.

## 5.7 Laser Tracking

When it is necessary to detect changes in the weld in real time during the welding process, the laser tracking function is needed at this time.

The following example

1	<ul> <li>主权</li> </ul>	(库	
2	÷	Start	
3	•	Move	
4	+	MoveL wp1	
5	φ	LaserSearchPose	
6		LaserTrack	
7		Move	
8		Movel start	
9	¢	ArcStart	
10	db lab	LaserTrack	
		Lave	
		Move	
12		MoveL wp0	

Program specification

In line 4, the robot opens the tracking point wp1

5 line start point search, put the result in the variable start

Line 6 Enables tracing and does not disable tracing at the end of setting

7 rows move to the starting point

9 Line arcing

Line 10 Turn on tracing and turn off tracing at the end of setting

The 11 lines teach a primitive track wp0

The robot will perform the following operations: turn on and enable the laser to obtain the arc starting point, turn on the tracking and move to the arc starting point, turn on the arc starting, turn on the tracking, calculate the deviation from the teaching trajectory according to the real-time acquisition of the feature points obtained by the laser sensor, and compensate the deviation to the teaching trajectory, so that the robot TCP can operate according to the detected weld.

## 5.8 Exception Detection

## Weld detection

LaserSearchPose can determine whether the return value is nil to determine whether the weld is detected. An example is as follows:

V 3	2程序	聞令	交量	ØR	18
-	Start		条件	语句	
Apple 1	LaserSearchPose	 <ul> <li>当数字轴</li> </ul>	入端口 011	V = LOW	
B	P If	 ● 条件表达	яî,		
	Move	 target	~= nil		
	+ MoveL target	 15to etsif	场加 else		
	Else	 352012375			
	88 Message	 漆加注释			

LaserSearchPose puts the search result in the variable target, and the If condition determines whether target is nil to perform the logic when the weld is detected and when the weld is not detected

Three/four point seeking deviation too large protection

In some cases, the weld may be detected incorrectly, resulting in excessive deviation of the calculated workpiece coordinate system, which can increase the deviation limit to prevent safety problems such as gun bump.

An example is as follows:



The Script function block uses the pose\_offset script to calculate the deviation of the original and new calculated coordinate systems, adding execution logic that determines that the deviation is greater than a certain range.