Read this manual before operation

- The content include of electric connections and operating steps
- Read the manual to ensure electric connection

LFS-PM-T43 automatic distance controller operating manual V1.0

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Contents

CHAPTER 1 INTRODUCTION 1

1.1 PRODUCT INTRODUCTION 1

CHAPTER 2 FUNCTION 2

2.1 TOUCH SCREEN 2

2.2 FUNCTIONS 3

2.2.1 MAIN MENU 3
2.2.2 PARAMETER SETTING 3
2.2.3 PARAMETER MANAGEMENT 5
2.2.4 ALARM INFORMATION 6
2.2.5 CAPACITY CALIBRATION 6
2.2.6 AUXILIARY CONTROL 7
2.2.7 SYSTEM INFORMATION 8
2.2.8 SYSTEM TIME 8

CHAPTER 3 ELECTRIC CONNECTIONS 10

3.1 INTERFACE OF THE CONTROLLER 10

3.1.1 Sensor INTERFACE 11
3.1.2 CN1 11
3.1.3 CN2 11
3.1.4 CN3 11
3.1.5 CN4 12
3.1.6 CN5 12
3.1.7 CN6 12
3.1.8 CN7 13
3.1.9 CN8 13
3.1.10 MOTOR 13
3.1.11 HMI 14
3.1.12 USB 14
3.1.13 LAN 14

3.2 LED INDICATOR 15

CHAPTER 4 TEST 16

4.1 TUNING 16

4.2 CUTTING TEST 17

CHAPTER 5 ALARM INFORMATION 21

5.1 INTRODUCTION OF THE ALARM 21

5.1.1 SYSTEM FAULT 21
5.1.2 LIMIT TRIGGER 21
5.1.3 RESET FAULT 21

5.1.4 CAPACITY FAULT 22
5.1.5 CRASH ALARM 22
5.1.6 EMERGNECY STOP 22
5.1.7 FOLLOWING ERROR 22
5.1.8 MULTI-ERROR 23

CHAPTER 6 ASSEMBLING 24

6.1 SIZE OF THE CONTROLLER 24

6.2 SIZE OF THE AMPLIFIER 24

APPENDIX TROUBLE SHOOT 25

Chapter 1 Introduction

1.1 Product introduction

LFS-PM-T43 is a automatic distance control system that based on the capacity sensor. This system has a 4.3” TFT touch screen and can display the work status and detecting capacity value. An advanced capacity detecting technology has been applied to have a stable and anti-interference capacity result. With this sensor detecting technology, the responsibility and accuracy have been improved. The key functions are just like following:

1) Control servo or step motors, high responsibility and accuracy。
2) Support crash alarm, limit trigger protection and servo alarm protection.
3) Automatic calibration and can compatible with the third party’s laser head.
4) Support focus distance modified on line. capacitor detecting scale is 0~9.9mm.
5) Work status of the laser head indicates and alarm indicates.
6) Support different setting of the rising height. Rising speed can be modified.
7) Auxiliary gas control. Support 3 channels auxiliary gas control。
8) Firmware updated by U disk。

Chapter 2 Functions

1.2 4.3” touch screen

This distance controller is included of a 4.3” touch TFT screen. The resolution is 480X272. the laser head work status is displayed in the monitor and parameters can be modified with the monitor. the display area is function button area, data display area, running status display area and alarm display area.

The main interface is just as the following:

- Function button area：touch the buttons can enter different function control menu.
- Data display：here is used to display the detecting value of the capacitor sensor and other set values。

  Focus position：the distance between the nozzle and the work piece.

  Actual position：the actual value of the capacitor detected.

  Following error：the error between the focus position and the actual position.

  Capacitor value：the value that the controller has detect from the capacity sensor；
- Running status ：display the status of the laser head.
- Alarm display：alarm status display. If there are several alarm triggered at the same time, user can touch the “alarm info” to check the alarm information in detail.

Main interface

The communication between the the controller and the touch screen monitor is by RS232.

If all the electrical connections has been done correctly, when power on the controller, the monitor of the controller will go to the main interface. If there are no error happened, that means the automatic distance controller work well.

But if the monitor indicate that connection failed because of the cable fault or other reasons，” connection failed” will be popped up. User should check the cable and the sensor devices.

1.3 Control functions

1.1.1 Main interface introduction

- **“tracing on/off”：** Enable or disable the tracing function. If it is tracing on, the color of the button will changed into green, which means the controller is under the tracing status. If the height of work sheet changes, the laser head will tracing the movement of the work sheet and always keep the distance to be a constant value. If it is tracing off, the tracing function is disabled. If the height of the work piece changes, the laser head has no response to that during the motion of the cutting system.
- **“fast/slow”：** is used to switch the manual speed to faster or slow.。
- “menu”：there are children menus in the menu to set some functions.
- “reset”：To reset the distance controller. Before running reset function, be sure that the upper limit has been installed correctly.

  NOTICE: There is danger during the reset operation because of the mechanical motion. So all the section should be checked before that and try to avoid of human harm.
- “±0.1”：modify the distance between the nozzle and the work sheet. Press one time, 0.1mm will increase or decrease 。
- “move up、move down”： to control the laser head to move up or move down. If the button is pressed, the laser head will be always moving until the button is released.
- “alarm info”：Press the button; user will go to the alarm information records interface. User can check the alarm information that happened recently. The maximum

number of the alarm record is 9.

- “Function”： go to the auxiliary gas test and capacitor calibration menu
- “system info”：check the version of the controller and multi-language selection.
- “system time”： modify the system time。

1.1.2 Parameter setting

Press “menu” to enter the interface of craft parameter setting, height parameter setting, velocity parameter setting, machine parameter setting and other parameters.

Notice : Before operating the distance controller, be sure that the parameters has already set correctly.

The sense of the parameters is shown as the table：

Control	**PID filter**	Increase the value will improve the responsibility of the laser head.
	Alarm time	Filter time for crash alarm protection. If the value is too small, the crash alarm will usually triggered because of the metal dross during cutting. If the value is too big, this will decrease the responsibility of the crash alarm protection.
	Gas delay	Auxiliary gas release time before cutting or piercing.
	Pierce gas	Auxiliary gas selection for piercing.

	Cutting gas	Auxiliary gas selection for cutting。
Height	**Rise posi**	The rising height for laser head during jump motion。
	Alarm posi	When the alarm triggered, the laser head is on the stop height
	Stdby posi	When the cutting task is finished, the laser head is on the position.
	Focus posi	The distance between the nozzle and the work piece
	Reset posi	When reset the laser head, the laser head will trigger the limit switch and move reversely for this distance
	Follow error	During a close control, the error between the actual position and referenced poison should never beyond the value. If that happened, system protection will be executed and generate the alarm of following error over limit
SPEED	**Rising spd**	Rising speed
	Tracing spd	The maximum tracing speed。
	Reset spd	Laser head reset speed
	fast	The manual fast speed
	slow	The manual slow speed
machine	**polarity**	Set the rotation of the motor
	acc	Motion acceleration。
	Screw pitch	Screw pitch
	resolution	When the motor rotate one round, the number of control pulse should sent to the motor drive
Other parameters	**Reset En**	Enable or disable the reset when power on
	Crash En	If the crash alarm is enabled, when the laser head has touched the work piece for a certain time(over the filter time), system will rise up the laser head and stop the motion of the cutting system If it is disabled, the crash alarm will be neglected.
	Lmt SNS	Set the sense of the limit switch. If a NPN limit switch is installed, user should set the polarity to be negative. If it is

		PNP, the polarity should be set to positive.
	LMT EN	If the limit protection is enabled, when the limit is triggered, the motion protection will take affect such as rising the laser head and stop motion.

1.1.3 Parameter management

Parameters management is used to save and restore the parameters of the distance controller. Not everybody can operate this function. There are passwords for user to manage this function. When user has configured all the parameters correctly, then these parameters can be set to be default. So if the parameters have been changed, user can restore the right parameters from the default. We suggest that user must save the correct parameters to be default when all the parameters have been tuned correctly.

1.1.4 Alarm information

On the main menu, press “ALM INFO” to go to “ALM INFO” interface.

User can check the alarm information. The information include of the alarm time and alarm source. The maximum records are 9 records that is saved. Press the “clear”, all the information is cleared. User still can press “page up” or “page down” to check the information.

1.1.5 Calibration

In the main menu, press “FUNCTION” to go to “CALIBRATION” interface.

Calibration is very important for a correct application of the distance controller. If the laser head has stand by for a very long time or the environment has changed a lot, a calibration should be done. If user has change or replace some parts of the capacitor, the calibration must be done again.

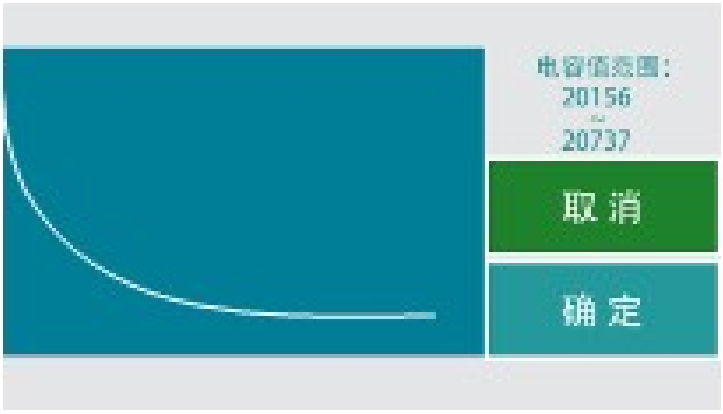
Before calibration, slowly moving the laser head to close to metal work piece and let the laser head to be standby status. Make sure that the metal sheet has been connected to the EARTH well and the machine also connects to the EARTH well. Then we can start a calibration. If the metal sheet is not connected to the earth well, the calibration may be failed. If the laser head is always moving down to touch the metal sheet and never stop, user should check the metal sheet conduct with the machine well or not. If the conduction is ok, then check the electrical connection and the capacitor sensor is good or not.

The normal calibration is just as the following:

- Laser head move down toward the metal sheet
- Touch the metal sheet and stop for while
- Then rise up to reach a position
- Then move down slowly
- Touch the metal sheet again then rise up to standby position

When the calibration is finished, a calibration curve will drew on the screen. The detection scale is also displayed. The curve indicates the response of the capacitor when the distance is

changed. If the curve is smooth and the value is in the desired scale, that means the calibration is successful. User can press “OK” to save the calibration data. If the calibration is not smooth and there are noises on it, that means the calibration is failed. User can press “CANCEL” to ignore the result. User should not save the calibration data. User should check the reason that has caused this situation and do the calibration again and again until the curve is smooth.



Because the capacitor is a sensitive to temperature and humidity of the environment, user should wait 3~5 minutes when power on to let the sensor and amplifier to reach a stable temperature.

1.1.6 Auxiliary gas test

In the main menu, press “FUNCTION” to go to the “AUXI GAS” interface.

This function is used to test the auxiliary gas is good or not. Auxiliary gas testing include of 3 channels auxiliary gas testing.

Testing steps：example for test the auxiliary gas with high pressure，press ”HP gas”，then the auxiliary gas channel is turned on. Release the button, then turn of the channel.

Notice ： Before testing the auxiliary gas, make sure the control system is in the standby status. Or the testing can not be done.

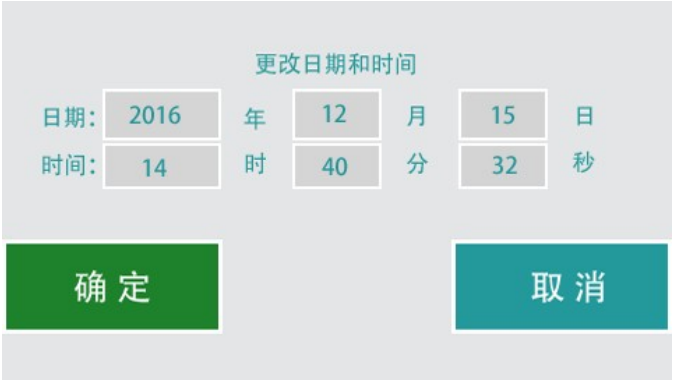
1.1.7 System info

Press “SYS INFO” to go to system information interface.

This page include of the language selection and the version of the controller.

1.1.8 System time

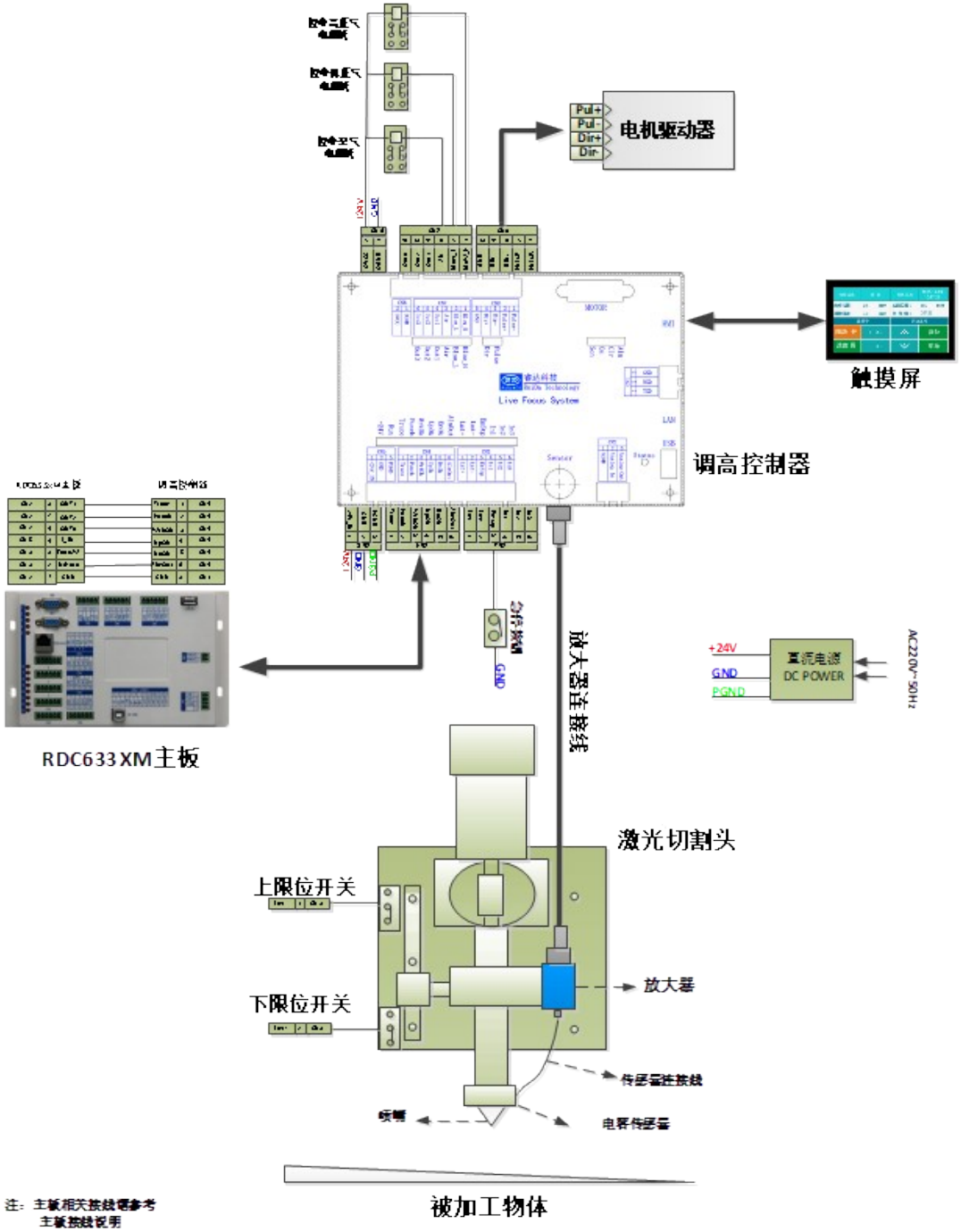
In the main menu, press the “date and time” to go to modify the date and time.



Chapter 2 Electrical Connection

1.4 Interface of the distance controller

The wiring diagram is just as follows：



1.1.9 Sensor interface

This interface is to connect the amplifier and distance controller。

When installing the amplifier, the shield of the amplifier should be have good conduction with the laser head (sensor and nozzle). There a wiring terminal on the shield of the amplifier. User can connect the terminal to the laser head. The metal sheet should still have a good

conduction with the machine. Or the capacity sensor will not work normally.

1.1.10 CN1 ----RS232

PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN 1	TXD	send data	—
PIN 2	RXD	Receive data	—
PIN 3	GND	GND	—

1.1.11 CN2----analog interface

PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN1	AGND	Analog GND	
PIN2	Analog In	Analog input	Input scale：0—10V
PIN3	Analog Out	Analog output	Output scale：0—10V

1.1.12 CN3----general input and output

PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN1	Lmt+	UP limit	24V level
PIN2	Lmt-	Down limit	24V level
PIN3	EmStp	Emergency input	Low level valid
PIN4	In1	General input	—
PIN5	In2	General input	—
PIN6	In3	General input	—

Limit switch include of up limit and down limit in the Z axis. support N.C and N.O mode. If the limit is N.O, the polarity should be set to be negative. If the limit is N.C, the polarity should be set to be positive.

The limit switch can be mechanical, opto-electric and magic type. But all the limit should be 24V standard. It can be OC interface mode.

1.1.13 CN4 control input

PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN1	Trace	随动控制信号输入	低电平时，处于随动下降并跟随，高电平

			时，处于随动上升
PIN2	Punch	穿孔信号输入	板卡穿孔信号，穿孔时，为低电平
PIN3	WrkOk	工作完成信号输入	工作完成状态信号输入，用于指示当前工作是否完成
PIN4	UpOk	上升到位信号输出	调高器上升到位则输出低电平
PIN5	DnOk	下降到位信号输出	调高器下降到位则输出低电平
PIN6	AlmOut	报警信号输出	当调高器发生报警时，该信号输出高电平，正常情况下输出低电平

控制主板与调高器之间采用 IO 口控制，其中包括：随动信号、穿孔信号、工作完成信号、上升到位信号、下降到位信号以及报警信号。接线如下图所示。

1.1.14 CN5 为外部输出接口

PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN1	+24V_IN	+24V 电源输入	+24V 电源输入，电源电流输出能力大于 2A
PIN2	GND	电源参考地	—
PIN3	PGND	外部屏蔽地	一般接大地、机壳

1.1.15 CN6 为外部输出接口

PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN1	OGND	外部电源参考地	外部参考地
PIN2	OVCC	外部+24V 电源输入	为 CN7 端子输出 IO 口提供 24V 电源

1.1.16 CN7 output

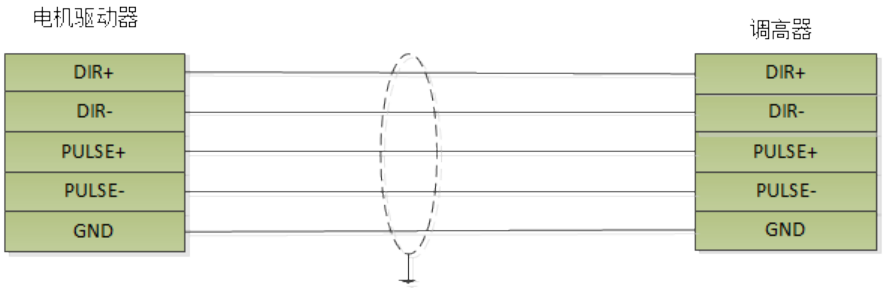
PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN1	Blow_H	High pressure gas control	Drive relay
PIN2	Blow_L	normal pressure gas control	Drive relay
PIN3	Air	Air control	Drive relay

PIN4	Out1	General output	—
PIN5	Out2	General output	—
PIN6	Out3	General output	—

1.1.17 CN8 motor control interface for step mode

PIN	SIGNAL	DEFINITION	DESCRIPTION
PIN1	Pulse-	—	—
PIN2	Pulse+	—	—
PIN3	Dir-	—	—
PIN4	Dir+	—	—
PIN5	GND	GND	—

1) To control step motor, differential mode and common-anode mode can be applied. We recommend user to select differential mode .



2) To control servo motor, please set the parameters correctly according to the operation manual of the servo drive。

- Set the servo drive to work at the position mode.
- The polarity of the pulse and direction.
- The number of pulse/per round

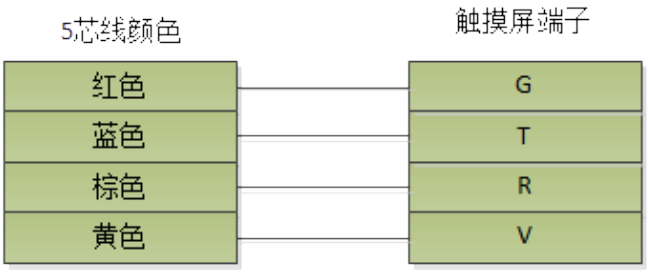
1.1.18 MOTOR control interface for servo mode

PIN（color of wire）	signal	definition
PIN1（yellow）	SPEED	+/-10V speed command
PIN2（blue）	OS	Zero speed
PIN3（black）	A+	Encoder A+
PIN4（orange）	B+	Encoder B+
PIN5（red）	Z+	Encoder Z+

PIN6（green）	SON	Servo on
PIN7（green/white）	CLR	Alarm clear
PIN8（brown）	+24V	+24V output
PIN9（yellow/white）	AGND	Analog GND
PIN10（blue/white）	GND	GND
PIN11（black/white）	A-	Encoder A-
PIN12（orange/white）	B-	Encoder B-
PIN13（red/white）	Z-	Encoder Z-
PIN14（purple）	ALM	Servo alarm input
PIN15（brown/white）	GND	GND

1.1.19 HMI

The connection between the distance controller and the displayer is shown as follows:



1.1.20 USB

USB is a U disk interface that used to upgrade the firmware.

LAN is a ETHERNET interface.

1.5 Led Indicator

LED name	Description
+24V	24V Power indicator
Run	System running indicator

Trace	Tracing signal indicator.
Punch	Piercing indicator
WrkOk	Work finish indicator
UpOk	Rising up ok indicator
DnOk	Tracing down ok indicator
AlmOut	Alarm indicator.
Lmt+	Up limit indicator. Low level input will turn on the led
Lmt-	Down limit indicator. Low level input will turn on the led
EmStp	Emergency stop input. Low level input will turn on the led
In1	Low level input will turn on the led
In2	Low level input will turn on the led
In3	Low level input will turn on the led
Status	U disk status
Alm	Servo alarm input. Low level input will turn on the led
Clr	Servo alarm clear. Low level input will turn on the led
Os	Zero speed status. Low level input will turn on the led
Son	Low level input will turn on the led
Pulse	Pulse signal indicator. Low level input will turn on the led
Dir	Direction signal indicator. Low level input will turn on the led
Blow_H	High pressure gas control output. Low level input will turn on the led
Blow_L	Normal pressure gas control output. Low level input will turn on the led
Air	Air control output. Low level input will turn on the led
Out1	Low level input will turn on the led
Out2	Low level input will turn on the led
Out3	Low level input will turn on the led

Chapter 2 Test and Run

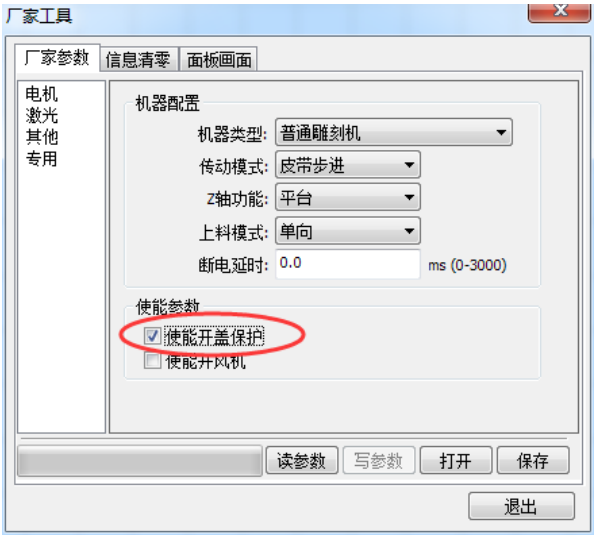
Test and run is based the RDC6332M cutting controller and the control software is Metal Cut.

1.6 Distance controller test

Before we start the distance controller test and run, the cutting control system and the distance controller should be wired correctly.

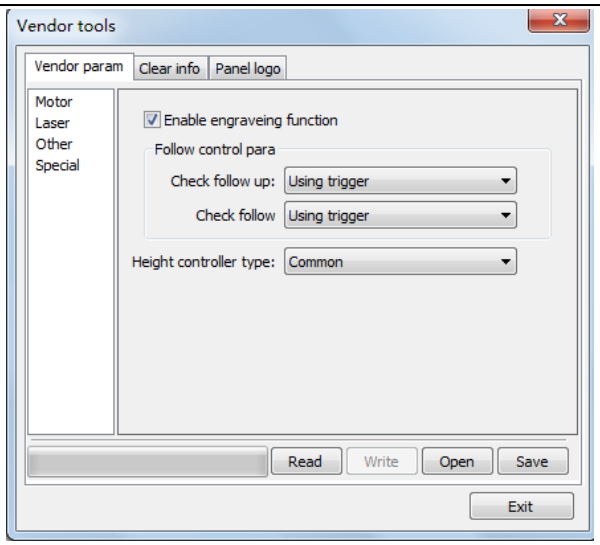
When you want to start a normal testing, the user parameter and vendor parameter should be configured correctly. Shown as the following:

MetalCut→FILE→VENDOR SETTING→OTHERS→ to enable “ENABLE PROTECT”：



MetalCut→VENDOR SETTING→SPECIAL→(the password is rdtsmm)→height controller type(common)→check follow up(use trigger)→check follow(use trigger).

Shown as following:



User still can selet the “check follow up ” to be “use delay” and the “check follow” to be “using trigger”.

The first operation should be careful. The following step should be noticed：

1) If the drive is servo drive, please set the parameters correctly according to the operating manual of the servo drive。
2) Then power on the distance controller, go to the “MENU”→“Setting”. Configure the parameters correctly.
3) To check the limit switch is good or not. User can trigger the limit manually. If it work well , the information of up limit trigger or down limit trigger will be displayed in the screen. That means the limits are working well.

   If the polarity of the limit is wrong, please check and modify the polarity of the limit in the menu.

   Then check the crash alarm is good or not. Just move the laser head or the work piece to keep they touch each other. If there are crash alarm information displays in the screen, which means the crash alarm is ok.
4) Press ，check the moving direction of the laser head，if the direction is not the desired direction, then modify the “motor polarity”。
5) Calibration. If the calibration result is good, then save the data.

6) Press “trace off”，the button will changed into green and the text will change into “trace on”. Press the “.” on the operating panel of the cutting system. The laser head will tracing down to the work piece and enter the tracing mode. Press “.” again, the laser head will rise to a certain position.

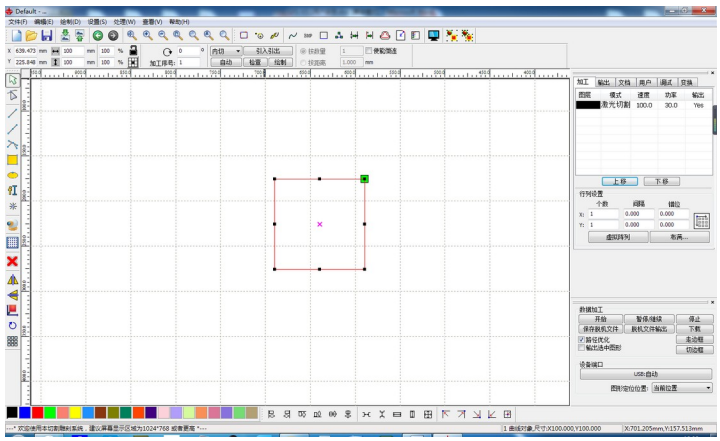
7) If all the steps is ok, that means the distance controller work well。

1.7 Cutting test

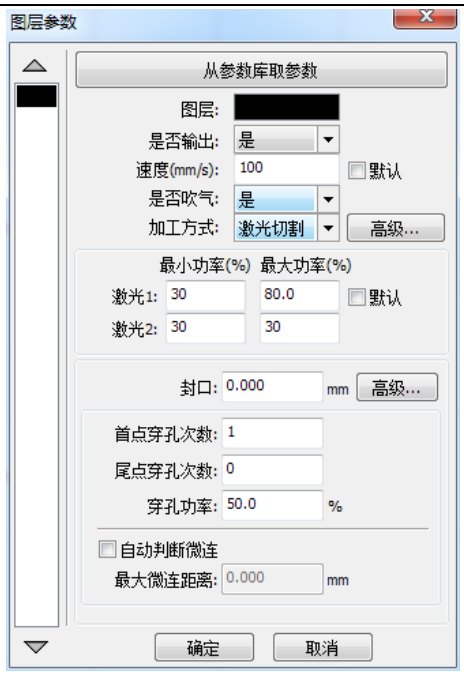
Before start a cutting, user should configure the parameters of the machine correctly. please reference to the RDC6332M controller operating manual.

Cutting test should follow the steps：

1) Open MetalCut ， draw a cutting rectangle with the drawing tools.



2) Set the layer parameter



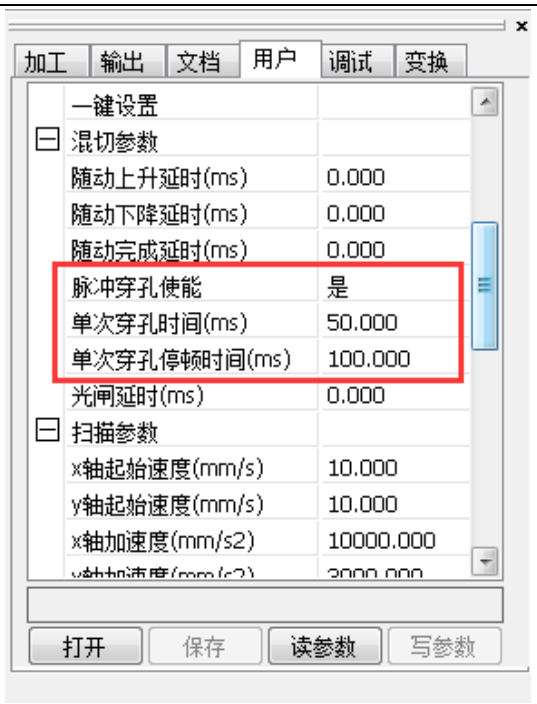
For laser piercing, the motion controller support CW piercing and pulse piercing mode. To set the piercing mode in the user parameters and layer parameters.

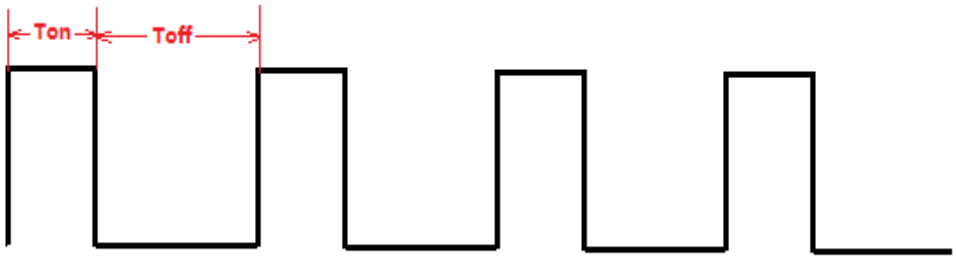
If laser CW piercing has been enabled, there is a continuous laser on the metal work piece for a certain time and then start a normal cutting. If it is pulse piercing, then the piercing time is decided by the piercing times (n) and single piercing time (Ton).

Piercing time = n*Ton

Pulse piercing is used to be applied for thick metal sheet cutting.

The following is a example for pulse piercing. The piercing times are 4 and the single piercing time is Ton. The interval time between 2 pulse is Toff。

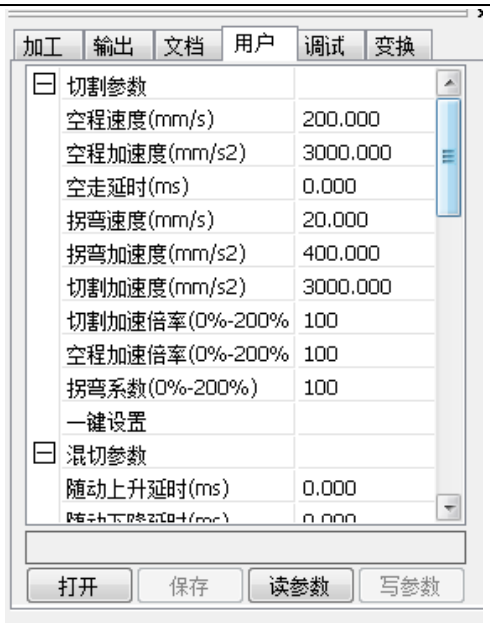




The total piercing time = 50*4 = 200ms；

User can set the laser power for laser piercing and the laser power for cutting.

3) User parameter setting



4) Auxiliary test

Press the “function” to go to “auxiliary test” page. This used to test the piercing gas and the cutting gas.

5) Laser emission test

In the operating panel of the motion controller, press “pulse” to test the laser.

6) Reference position

Move the laser head to a referenced position. Press “reference” and the current position is set to be the zero position.

7) Frame

After set the referenced poison, press “Frame” to execute a frame motion.

8) Start cutting

Press “start” to start a normal cutting。

Chapter 5： alarm information

1.8 Description of the alarm

During the running, there maybe some alarm happened because of some undesired conditions. The alarm information will be considered and some protection should be executed. The alarm information include of up limit trigger, down limit trigger, reset fault, crash alarm, following error over limit, emergency stop and sensor failed. When one or several alarm happened, the information will be displayed on the displayer. User should check the reasons that have caused the alarm and clear the alarm.

1.1.21 System fault

It is a system fault. When the hardware or the firmware is failed, the alarm happened. When the alarm happened, the system will stop motion. User should check the distance controller and power on it again. If the alarm is still there, user should take a new controller to replace that one.

1.1.22 Up/down limit trigger

When the limit protection has been enabled, the system will display the limit trigger information once the limit is triggered. If there are limit triggered, there may be the following reason：

- The sense of the limit switch is set incorrectly.
- Wrong wiring；
- Limit switch fault or the voltage level is not 24V.

1.1.23 Reset error

There may be the following reasons to cause the reset error：

- When resetting, the laser head have no motion or the speed is too low and has caused a timeout action. Please check the parameters of the distance controller.
- The polarity of the motor is wrong. When resetting, the laser head move down to trigger the down limit.

1.1.24 Capacity fault

If the current detected capacity value is too small, then the capacity fault will displayed. There may be the following reasons:

- Do not do a calibration for a long time or the humidity and temperature has changed a lot. Do a calibration again to clear this fault.
- Part of the sensor has been replaced and installed again. Do a calibration again to clear this fault.
- There are bad connections of the wire. Check the wire connections。
- Work piece do not have a good conduction with the shield of the amplifier. Check the wire to the earth and the wire on the amplifier shield.
- Parts of the laser spot are located on the capacity sensor and cause the temperature rising. Please check the optical path and the optical devices.

1.1.25 Crash alarm

When the laser head has touched the metal work piece for a certain time, the crash alarm will be displayed on the displayer. If the laser head do not touch the metal sheet, there is still crash alarm displayed. There may be the following reasons:

- There is a short between the nozzle and the shield of the amplifier.
- The axial cable between the amplifier and the capacity sensor is damaged or the amplifier does not work.

- The capacity value of the sensor has been out of the detecting range of the distance controller.

1.1.26 Emergency stop

When a low level signal is input to the emergency port, system will stop all the motion immediately. If the input is keep high level and there is still a emergency triggered, the following reasons may cause that.

- Wrong wiring。
- Machine electrical interference. Please check the wiring connection to the EARTH.。

1.1.27 Following error over limit

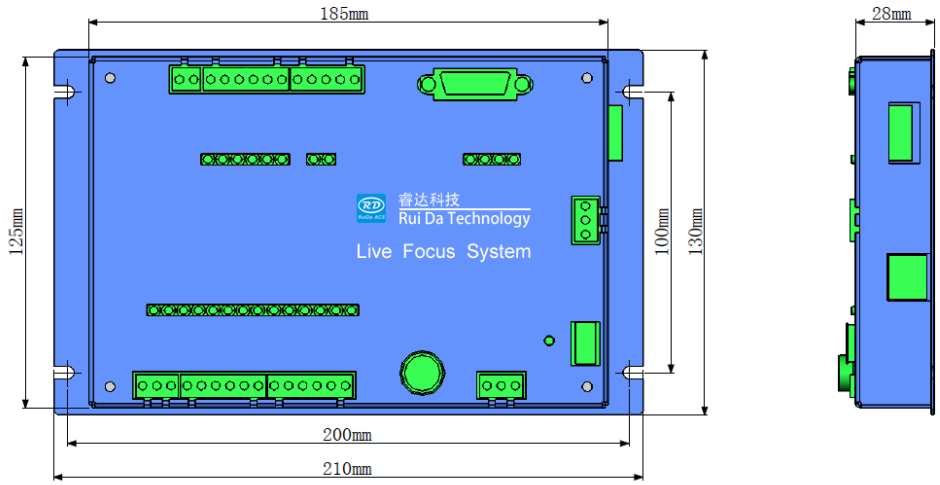
There is big error between the referenced distance and the actual distance of the laser head. Please modify the PID parameters or increase the limit value.

1.1.28 Multi-error

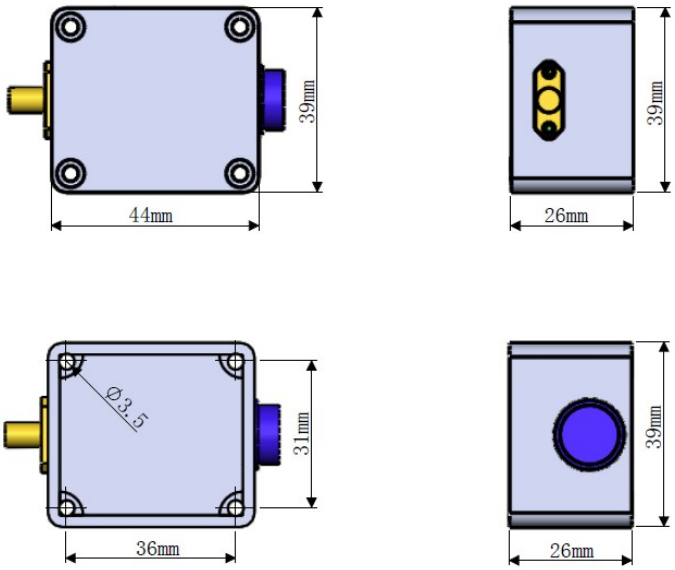
When there are several alarm triggered at the same time, the multi-alarm information will be displayed on the displayer. User can go to “alarm info” to check the alarm information in detail.

Chapter 6 Installing

1.9 Size of the distance controller



1.10 Size of the amplifier



Appendix: Trouble shoots

FAULT	MAIN REASON	SOLVED
Manual moving up and down function failed	Wiring of DIR+、DIR- 、PULSE+、PULSE-is not correct.	Reference to the manual to ensure a right connection
	Parameters of Servo drive is not correct	Reference to the servo drive operating manual
	There is no serve on to the drive	Enable the servo drive internal or by external signal
	Connection between the distance controller and the displayer is not correct	Check the wiring
	Emergency trigger	Release the emergency input
“no connection” on the dispalyer	Wrong connection between the dispalyer and the distance controller	Check the wiring
	The dispalyer do not match with the distance controller	Check the version of the distance controller
	Controller hardware port is damaged.	—
	Displayer hardware port is damaged.	—
“unmached HMI” on the dispalyer	The firmware is not match with the dispalyer	Check the version of the distance controller
During calibration, the laser head moving down and no stop when touch the metal sheet.	Dross on the nozzle has caused the capicity changed a lot	Clear the nozzle
	Metal sheet do not have a good conduction with machine.	Have a good conduction between the metal sheet and the machine
	Metal sheet have a plastic film	Clear the palstic film
During calibration , calibration failed is displayed.	During the calibration, “stop” is pressed.	—
	When calibration, the laser	When calibration, move the

	head is too far away from the metal sheet.	laser head close to the metal sheet.
	During the calibration, up limit or down limit triggered.	Before calibration, check the positon of the laser head. Move the laser head away from the limit
	There is no motion and cause a time out	Check the parameters of the servo drive and can run a jog motion
“write para” can not write the parameters into the distance controller	The laser head is in the running status.	Stop motion and set laser head to be standby status
	wrong connection between the displayer and the distance controller.	Check the wire and the interface
There is big erro between the actual height and the referenced height	no calibration for a long time	Calibration again
	Has changed some parts of the sensor but do not do the calibration.	Calibration again
	Some laser beam is located on the capacity sensor or the lens is dirty and make the sensor ‘s temporature increasing.	Check the lens is clean and the position of the laser beam
	Auxiliary gas has caused the capacity changing	Check the cleaness and the humidity of the auxiliary gas
Laser head shaking during tracing	Shield of the amplifier do not have good conduction with the machine	Chenck the EARTH wire is connected well
	PID parameter is not normal	Decrease the P parameter and decrese the responsibility of the distance controller
	Before start a normal cutting. Calibration is not done or the calibration result is not so good.	Calibration again
	Servo stiffness is too big	Decrease the stiffness
	Servo electrical interference	Check the shield of servo drive is connect to the EARTH. Connect

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