TC55H 2016 Instruction Manual

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1. Product Introduction

The TC55H is an upgraded version of the TC55 controller. It can control 4 feeding axis and 1 analog spindle. It is equipped with 16 input ports and 8 output ports, and supports importing files from USB sticks.

2. Technical Specifications

Minimum data unit 0.001 mm

Maximum data size ± 99999.999mm

Maximum Speed: 24m/min (pulse is 0.001 mm)

USB Port Importing Programs and Boot Picture

2ms interpolation cycle

Frequency for Single Axis Linear Interpolation Output Pulse is 400k

Frequency for Circular Interpolation Output Pulse is 300k

Frequency for Four Axis Linear Interpolation Output Pulse is 350k

Axis 1-4 (X, Y, Z & C)

X, Y, Z & C axes are suitable for linear interpolation. Only X & Y axes can do circular interpolation.

Electronic Gearing: Numerator : 1-99999, Denominator : 1-99999

USB: For Importing NC Programs and Boot Page Pictures

Optically Isolated I/O ports

Maximum number of Program Lines: 799

Maximum number of Programs: 99

RAM: 128M

External Manual Operations: Motors clockwise and counter clockwise, Start, Pause, Alert, and Stop

Subset of standard G-codes and User Programmable M-codes

On-panel MPG

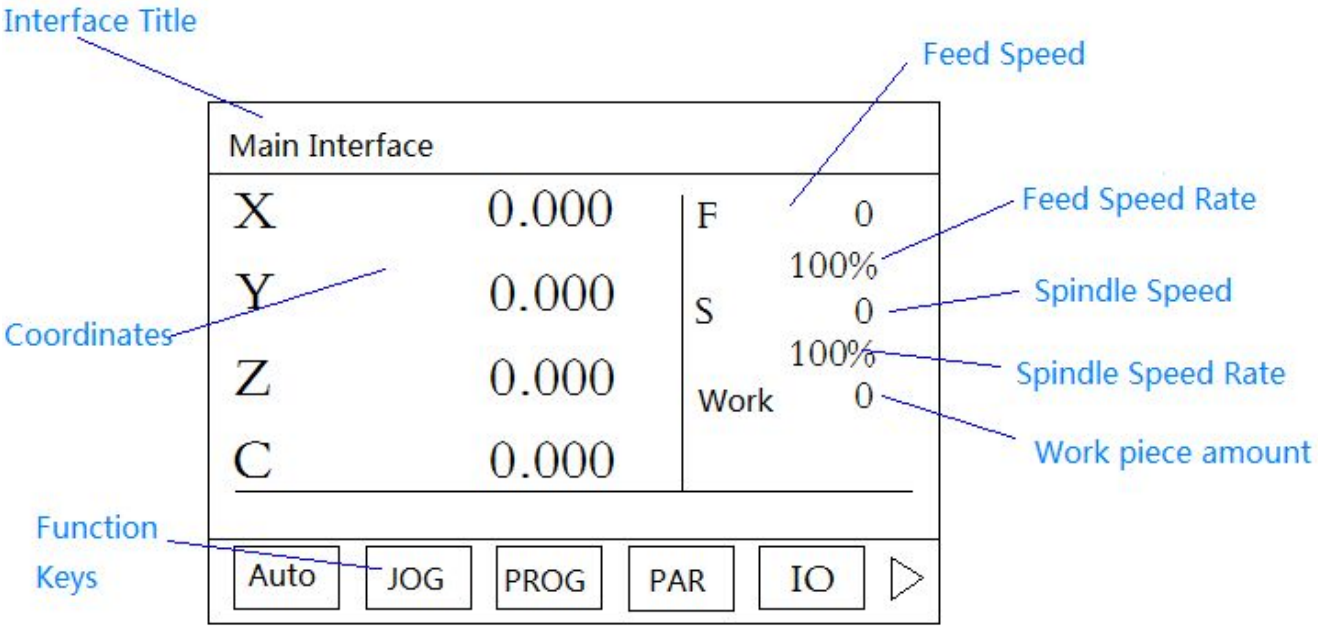
3.5 inch color LCD, 320*240 pixels

Analog Spindle Output: 0-10v DC

User definable external I/O Switches

Operation

1. Main Interface:

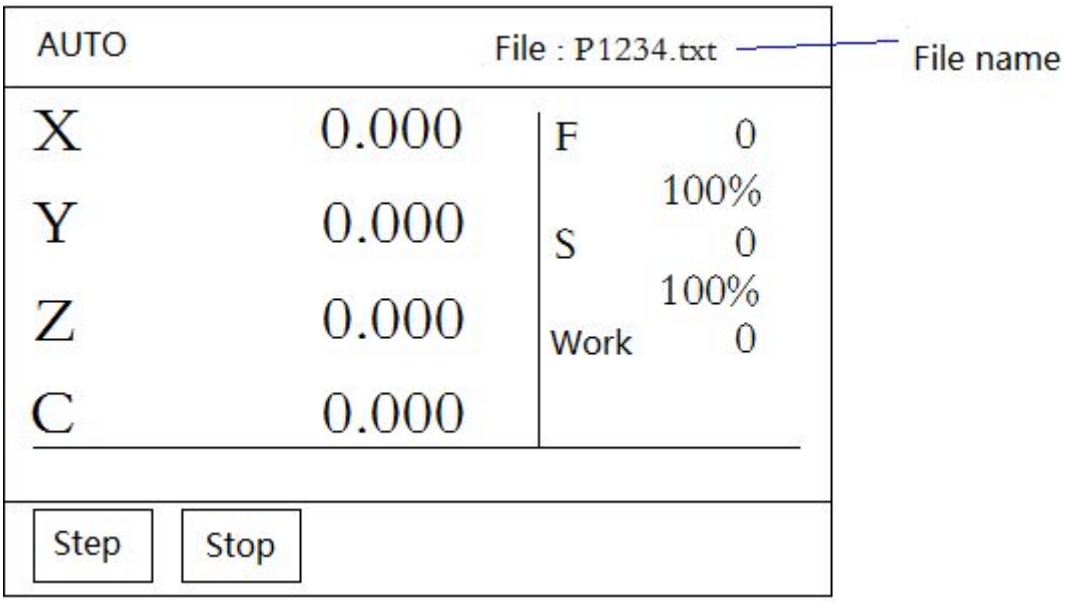


This is the interface display after booting without a boot picture. It shows the coordinates of each axis, Feed rate, Spindle Speed and amount of work pieces. P1000 indicates the program currently running, and 123 means the input method. The AUTO, JOG, PROG, PAR, & IO, as well as the password interface pages are directly accessible from here.

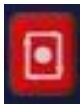
Feed Speed Rate: The actual feed speed= F*Feed Speed Rate. Press " ↑ ", then the feed speed rate will gain 1; long press " ↑ ", then the feed speed rate will gain 10%. Press " ↓ ", then the feed speed rate will lose 1; long press " ↓ ", then the feed speed rate will lose 10%.

Spindle Speed Rate: The actual spindle speed=S*Spindle Speed Rate, (10%-150%). Press "R", the spindle speed rate will gain 10; press "S", the spindle speed rate will lose 10.

2. Auto:



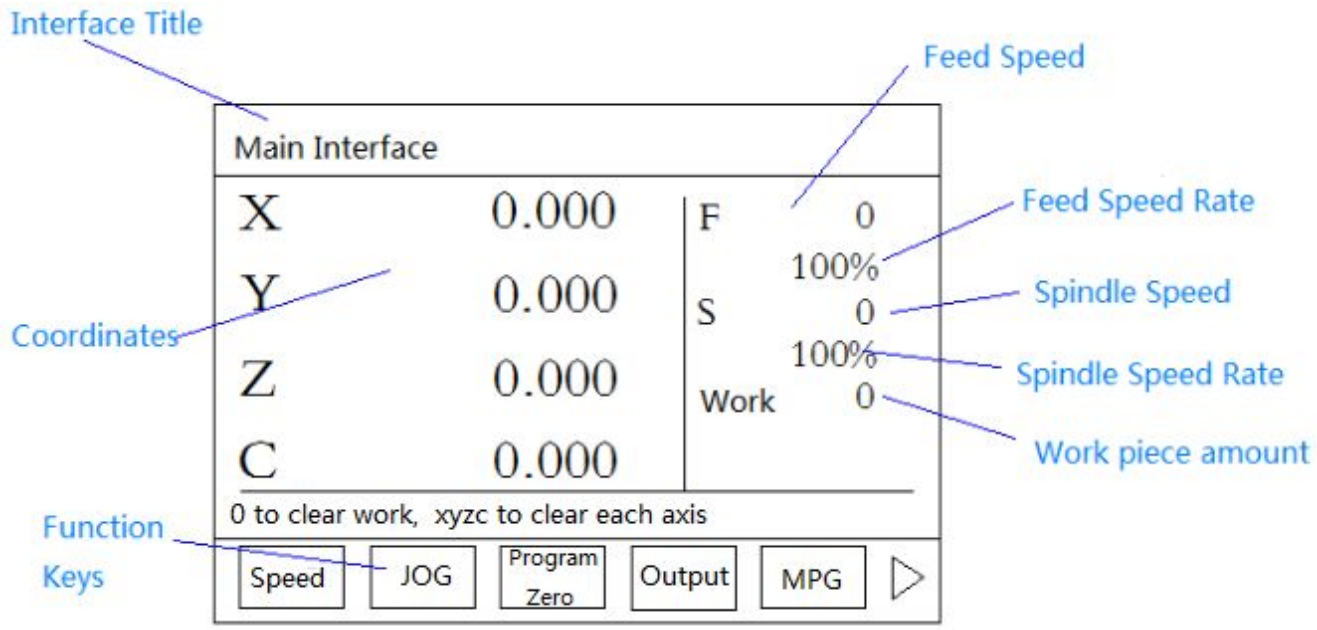
In **Auto** Interface, Press the **Start** Button  to run the current/last-read program.

Press **Pause**  to Stop.

2.1 Step:

A Positive display means the program will run continuous Automatic Operation. A Negative display means it will operate line by line, and the next line will be executed each time the Start button is pressed.

3. JOG:



- Press X, Y, Z or C to choose the desired axis.
- Press the S Button to increase the programmed Feed Rate, and the N Button to decrease. (10%-150%)
- Press the R Button to increase programmed spindle speed, and the S Button to decrease. (10%-150%)
- Press **Shift** to select the output port, and press **Enter** to toggle ON or OFF.
- Press ← and → for continuous selected Axes movement.
- Press ←and → for step jogging, define the jog distance in the ***PAR-Control-Jog+Distance*** parameter. Define the jog speed in ***PAR-Speed-Jog***.

3.1 Speed:

Negative display means manual high speed(***PAR-Speed-Man Hspd***), and Positive display means manual low speed(***PAR-Speed-Man Lspd***). Press ← and → for continuous motor rotation.

3.2 Jog:

Press ←and → for step jogging, define the jog distance in the ***PAR-Control-Jog+Distance*** parameter. Define the jog speed in ***PAR-Speed-Jog***.

3.3 Program Zero:

Pressing this key will command the all axis to go back to reference point(***Par-Control***) at high speed, as defined in ***Par-Speed***.

3.4 Output:

Press 1-8 to control the status of each output port.

3.4 MPG:

Press **MPG**, then move the wheel up, and the selected axis will incrementally move in the Positive direction. Move the wheel down, and the chosen axis will move in the Negative direction. Press **X10X100** to change the cardinal increment number which shown on the top of the screen.

Status	Cardinal Number
X1	0.001 mm
X10	0.01 mm
X100	0.1 mm

4. PAR:

4.1 Ctrl:

Control parameters setting area. Long press ↑ and ↓ to change page.

- **Language**: English or Chinese
- **X/Y/Z/C Numerator**: Electronic gearing ratio (1-99999)
- **X/Y/Z/C Denominator**: Electronic gearing ratio(1-99999)
- **X/Y/Z/C Reference**: In manual operation, long press X/Y/Z/C to clear the coordinates and show this value; or in machine zero, after hit the switch, it will show this value.
- **X/Y/Z/C Gap(um)**: Backlash to make it more precise
- **X/Y/Z/C Zero Start**: **[off]** means the axis will not go home automatically after booting; [on] means the axis will go home automatically after booting
- **Speed+Time(ms)**: Time for motor to reach full **F** speed.
- **Jog+Distance**: Jogging Increment in Manual Mode. Jog distance depends on electronic gearing ratio.

4.1.1 Setting of the Electronic Gearing Ratio:

Setting data of the electronic gearing ratio is usually different for different machines. Different axes of the same machine can be set based on different units. (For example, Axis A can be set as mm of movement, Axis B can be set as angles, and Axis C can be set as rotations.)

How to determine the Numerator and Denominator of the electronic gearing ratio:
Number of Pulses for the motor to turn one complete rotation in the same direction: (=***N***)
Distance the axis moves when the motor turns one complete rotation in the same direction (in μm =***D***)
(Numerator and Denominator must both be integers between 1 and 99999.)

Example 1/: Screw Transmission.
Stepper motor is 800 ppr, or servo motor is 800 pulses per complete 360 Degree rotation. (=***N***)
Lead Screw / Ball Screw pitch is 0.2 mm (=***P [* 1000***])
Reduction ratio is 1:1. (=***R***)
Formula: Gearing Ratio = N / (P * R)
Then for ***N*** = 800 ***P*** = (0.2 * 1000), ***R*** = 1:1.
800/ (0.2 * 1000 * 1) = ***4/ 1***

Example 2/: Rack and Pinion.
Stepper motor is 6000 ppr, or servo motor is 6000 pulses per complete 360 Degree rotation. (=***N***)
Pinion Gear has 20 teeth. (=***G***) Module(=**M**) is 2
D = N/ G*M*π*1000, given that D = 6000 / 20*2*3.1415926535898 *1000→ D = 107 / 2241

Example 3/: Rotary Angle
Stepper motor is 5000 ppr, or servo motor is 5000 pulses per complete 360 Degree rotation. (=***N***)
Reduction ratio of gearbox is 1:30. (=***R***)
Then: Angle ***A*** = ***N*** * ***R*** / (360 * 1000)
Therefore ***A*** = 5000*30 / 360 * 1000 → ***A*** = 150000 / 360000 = 15 / 36

4.2 Speed:

- **SHspd**: The highest speed of the spindle when analog voltage is 10V.
- **Syn_Hspd(mm/min)**: Highest speed synthesized by Axis X, Y, Z and C.
- **StartSpd(mm/min)**: Speed during ***Speed+Time***
- **Man Hspd**: Manual high speed

- **Man Lspd**: Manual low speed
- **Jog Spd:** Jog Speed
- **BZHSpd**: Go home at high speed.
- **BZLSpd**: Go home first at high speed, through zero switch, and move back at low speed. Finally slider will stop on the switch.
- **BMZ Mode**: Two modes to go home, through switch or not. 0 = Through switch: slider will stop on switch. (1) = Not through switch: Slider will stop before the switch.

4.3 Factory Value:

- Please Press enter to restore factory value

4.4 User:

User Code: 123456

- Users have to log in before changing parameters and setting I/O.

4.5 Password:

- Reset the customer code.

5. IO:

This function enables the users(log in) to set the I/O ports for various kinds of tasks.

5.1 System

This function unable user to set various kind of switch easily. Define the I/O port according following form. Press I/O key on the panel to enter this interface.

Functions	Interpretation	Methods
X Axis Lim+	X axis Positive limit setting	External switches are required to for external controls. External switches are initially set as Normally Open. Press **Shift** to change *off* into *on*, and also **Shift** to choose **N/O - N/C**. (Normally Open /
X Axis Lim-	X axis Negative limit setting	
Y Axis Lim+	Y axis Positive limit setting	
Y Axis Lim-	Y axis Negative limit setting	
Z Axis Lim+	Z axis Positive limit setting	

Z Axis Lim-	Z axis Negative limit setting	Closed). Then select the desired I/O Port number in the blank. Note: For safety reasons, ***Limit*** and ***Emergency Stop*** inputs are usually set as N/C. (Normally Closed)
C Axis Lim+	C axis Positive limit setting	
C Axis Lim-	C axis Negative limit setting	
AlerInpu	Alert Input	
EmStInpu	Emergency Stop Input	
X 0	X axis zero switch setting	
Y 0	Y axis zero switch setting	
Z 0	Z axis zero switch setting	
C 0	C axis zero switch setting	
OutStart	Outside(External) Start Switch Setting	
Out EmSt	Outside(External) Emergency Stop Setting	
Spd+Inpu	Speed Increase Outside Switch	
Spd-Inpu	Speed Decrease Outside Switch	
OutPt 1-8	External input port control output port	

5.2 Jog

This function is normally used in manual adjusting parameters of machine to reach a optimal situation.

Functions	Interpretation	Methods
X HSup	X axis high speed up	Choose on or off Choose N(Negative) or P(Positive)
X HSdown	X axis high speed down	
X LSup	X axis low speed up	
X LSdown	X axis low speed down	
Y HSup	Y axis high speed up	
Y HSdown	Y axis high speed down	
Y LSup	Y axis low speed up	
Y LSdown	Y axis low speed down	
Z HSup	Z axis high speed up	
Z HSdown	Z axis high speed down	
Z LSup	Z axis low speed up	

Z LSdown	Z axis low speed down	
C HSup	C axis high speed up	
C HSdown	C axis high speed down	
C LSup	C axis low speed up	
C LSdown	C axis low speed down	
X ZeroSt	X axis Machine zero external manual switch	
Y ZeroSt	Y axis Machine zero external manual switch	
Z ZeroSt	Z axis Machine zero external manual switch	
C ZeroSt	C axis Machine zero external manual switch	
Prog Zero	All axis go back to reference point	

5.3 Outputs:

Use this interface to define the operation of Output Ports 1 to 8. You can then use these in your programs. If you want an output port to open and close, then you will need to set two M value. For example, you should set M51: Output 1 on as output 1 open, then you should set M52:Output 1 off as output 2 close.

M03-M04 is for spindle direction C/W or CCW.

5.4 Input Detect:

This interface is to detect the signal of the 16 input ports, 0 means off and 1 means on.

5.5 Output Detect:

This interface is to detect the 8 output ports, 0 means off and 1 means on. Use **Shift** to turn on or off.

6. USB:

- Boot Picture Names : ****.bmp : (320*240 Pixels only, 24 bit color bmp)
- Program Name: ****. TXT or ****. txt

Note: Please follow the naming format strictly, or the controller will not be able to read the file.

Programming

1. Introduction

1.1 Code Explanation

(* Some Code may mean something different in a different place.)

Code	Number Range	Meaning
N	0~9999	Sub program name
N	0~99999	Main Program Name
G	0~99	G code
X	+0.001~ +99999.999 (mm)	X axis
Y		Y axis
Z		Z axis
C		C axis
R	+0.001~ +99999.999mm	Radius
K	0.001~99999.999s	Delay Time in Seconds
F	0~99999	Feed Rate
S	0~99999r/min	Spindle Speed
M	00~99	M code

2. G-Code

Non Modal G-Code: Valid only in the active Program Line.

Modal G-Code: Remains valid until another G code of the same Group is used.

G-Code	Modal	Format	Function
G00	**Modal**	G00 X_ Y_ Z_ C_	Rapid Positioning
G01		G01 X_ Y_ Z_ C_ F_	Linear Interpolation
G02		G02/G03 X_ Y_ R_ F_	Clockwise Interpolation
G03			Counter Clockwise Interpolation
G04	Non-Modal	G04 Kxxxxx.xxx	Delay Time: K = Seconds
G20	Non-Modal	G20 Nxxxx.xxx Numbers after N = Sub-program name, followed by number of times to repeat.	Sub-program Call
G22	Non-Modal	G22 Nxxxx Numbers after N： subprogram name	Subprogram Start

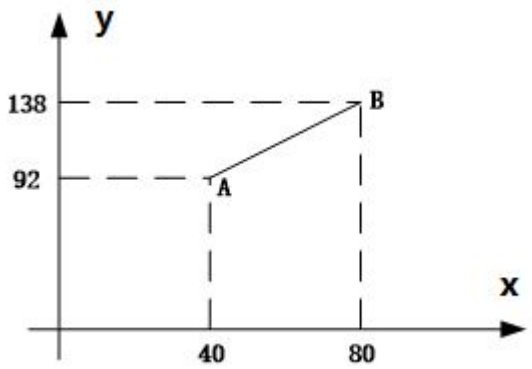
G24	Non-Modal	G24 Note: G22 and G24 must be used in pairs	Subprogram End
G25	Non-Modal	G25 Nxxxxx	Skip to line Nxxxxx
G90	**Modal**	G90	Absolute Programming
G91		G91	Incremental Programming
G92	Non-Modal	G92 X_ Y_ Z_ C_	Set Active Coordinates
G60	Non-Modal	G60	Accurate Path Mode(Defaulted)
G64	Non-Modal	G64	Consecutive Path Mode
G74	Non-Modal	G74 X_ Y_ Z_ C_	Go home

2.1 G00 - Rapid Positioning:

Format：**G00 X_ Y_ Z_ C_**

Note: Set the maximum axis speed in **Parameters-Speed**.

Example.：Move the Tool from A to B at the maximum rapid rate.



Absolute Programming:

N001 G90

N002 G00 X80 Y138

or

N001 G90 G00 X80 Y138

Incremental Programming:

N001 G91

N002 G00 X40 Y46

or

N001 G91 G00 X40 Y46

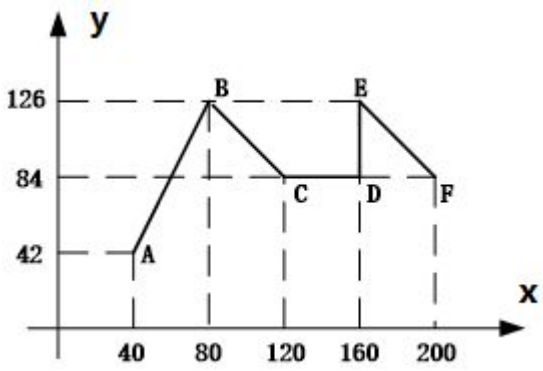
2.2 G01 - Linear Interpolation:

Format: **G01 X_Y_Z_C_F_**

(Note: If a **Feed Rate** is not set, the axis will move at the Starting Speed, as set in Parameters-Speed.)

Example.:

Absolute Programming:



N001 G90

N002 G00 X80 Y126 A→B

N003 G01 X120 Y84 F500 B→C

N004 X160 C→D

N005 Y126 D→E

N006 X200 Y84 E→F

Incremental Programming:

N001 G91

N002 G00 X40 Y84 A→B

N003 G01 X40 Y-42 F500 B→C

N004 X40 C→D

N005 Y42 D→E

N006 X40 Y-42 E→F

2.3 G02 – Clock-wise Interpolation:

Format: **G02 X_ Y_ R_ F_**

Note:

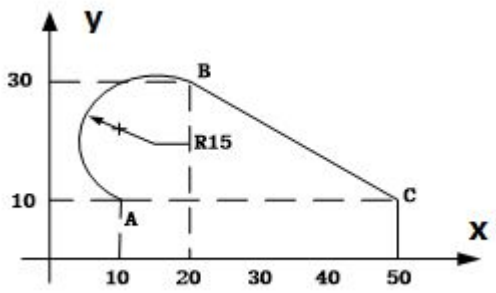
（1）**F** is the speed

（2）A Full Circle cannot be machined in a one line operation. Split into semi-circles(2 program lines).

（3）**R** is the radius, "**+R**" used when the arc is <180°, "**-R**" is used when the arc is >180°.

（4）The distance between starting point and end point has to be less than 2***R**, otherwise it will not run.

Example:



Absolute Programming:

N001 G90

N002 G02 X30 Y20 R15 F800 A→B

N003 G00 X10 Y50 B→C

Incremental Programming:

N001 G91

N002 G02 X20 Y10 R15 F800 A→B

N003 G00 X-20 Y30 B→C

2.4 G03 – Counter-Clockwise Interpolation:

Format：**G03 X_ Y_ R_ F_**

Note:

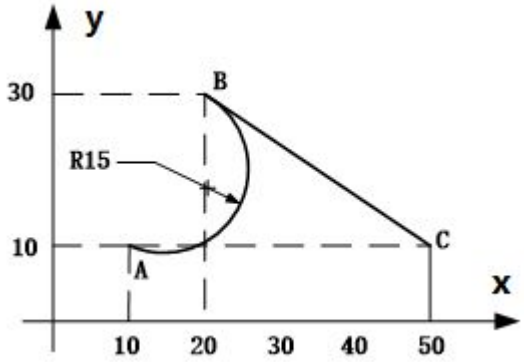
（1）**F** is the speed

（2）A Full Circle cannot be machined in a one line operation. Split into semi-circles(2 program lines).

（3）**R** is the radius, "**+R**" used when the arc is <180°, "**-R**" is used when the arc is >180°.

（4）The distance between starting point and end point has to be less than 2***R**, otherwise it will not run.

Example：



Absolute Programming:

N001 G90

N002 G03 X20 Y30 R15 F800 A→B

N003 G00 X50 Y10 B→C

Incremental Programming:

N001 G91

N002 G03 X10 Y20 R15 F800 A→B

N003 G00 X30 Y-20 B→C

2.5 G04 - Delay Time:

Format：**G04 K**xxxxx.xxx

Note：0.001~99999.999s

Example：**G04 K5** *Delays further program execution by 5.0 Seconds.*

2.6 G20 - Subprogram Call:

Format：**G20 N**xxxx.xxx

Note：

（1） xxxx means subprogram name, xxx means repeat times.

（2）Repeat time: 1~999

（3）If repeat time is 0 or not filled, G20 will repeat once only.

Example:

N010 G20 N234.10 Call the Sub-program named 234, and repeat it 10 times.

N100 G22 N234 Start of Sub-program 234

N101 G91 Incremental Programming

N102 G01 X10 Y10 F500 Linear Interpolation

N103 G24 Subprogram End

2.7 G25 – Skip:

Format: **G25 N**xxxxx

Note: number after N means the line skip to

Ex：

N001 G00 X10 Y10 Rapid Positioning

N002 G01 X800 Y300 F1500 Linear Interpolation

N003 G25 N001 Skip to N001

2.8 G92 – Pre-Set Coordinates:

Format: **G92 X_ Y_ Z_ C_**

Note: Set specified location as new reference coordinates.

(**G92** Can be used to set the machine coordinates for different job lengths or tool offsets.)

2.9 G60- Accurate Path Mode(Defaulted)

G60 has to occupy a single program line to be functioned. It stays between two program lines. After the line before G60 is operated, the speed will become ***StartSpd.*** Then it will change into the speed of the program line after G64.

2.10 G64- Consecutive Path Mode

G64 has to occupy a single program line to be functioned. It stays between two program lines. After the line before G60 is operated, the speed will become speed of the program line after G64.

2.11 G74- Go Home

G74 X_ Y_ Z_ C_ , the value after X,Y,Z and C is the coordinates shown after hitting the switch.

3. M-Codes:

M Codes are used for machine control Auxiliary outputs.

Code	Functions
M02	Program End
M03	Rotate Spindle Clockwise
M04	Rotate Spindle Counter-clockwise
M05	Spindle Stop
M47	Work pieces clear 0
M48	Work pieces gain 1
M51~M66	Open or Close corresponding output port. (As defined in Parameters)

Example:

（1） Select **PAR-Output.**

（2） Select ***Output 1*** for **M51**.

（3） Press **Enter** to turn the port from “Off” to “On”.

（4） Press **ESC**, then press **Enter** to save your changes.

（5） Press **PROG**, then **NEW**, type in a ***New Program Name***, then press **ENTER** to begin editing;

N001 S200 M03	*Rotate Spindle clockwise at 200 r/min.*
N002 G04 K5	*Delay for 5.0 Seconds*
N003 G01 X100 Y100 F1500	*Linear Interpolation*
N004 S300 M04	*Rotate Spindle counter-clockwise at 300 r/min.*
N005 G04 K5	*Delay for 5.0 Seconds*

N006 G01 X50 F1500 *Linear Interpolation*

N007 M05 *Spindle stop*

N008 M51 *Activate Output Port #1*

N009 M02 *Program End*

（6） After editing, press **Save**, then press **Auto** and **Start** to run.

4. Spindle:

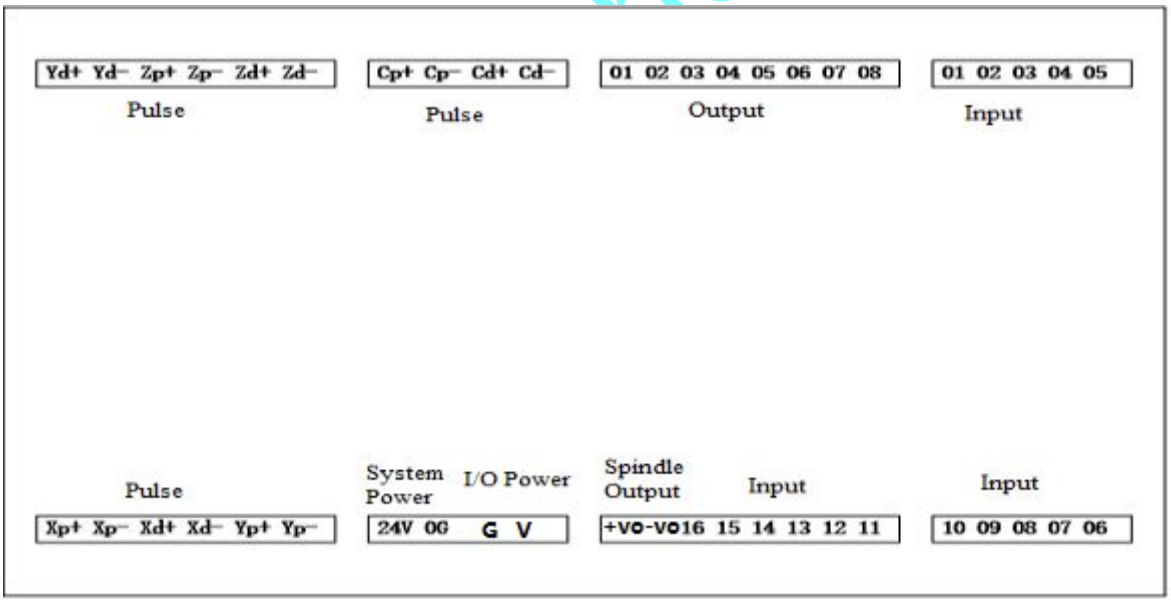
The **S** code is used to control the speed of the Main Spindle. The TC55H controller uses analog voltage between 0 and 10V DC to control the spindle speed.

(Note: Any programmed **S** code will not be retained in memory after power off.)

Example: **N001 S1000 M03** Spindle will rotate clockwise at 1000 r/min.

Connection Diagram

1. TC55H Rear View:



2. Wiring Instruction

Xp+	X axis pulse positive output
Xp -	X axis pulse negative output
Xd+	X axis direction positive output
Xd-	X axis direction negative output
Yp+	Y axis pulse positive output
Yp -	Y axis pulse negative output

Yd+	Y axis direction positive output
Yd-	Y axis direction negative output
Zp+	Z axis pulse positive output
Zp -	Z axis pulse negative output
Zd+	Z axis direction positive output
Zd-	Z axis direction negative output
Cp+	C axis pulse positive output
Cp -	C axis pulse negative output
Cd+	C axis direction positive output
Cd-	C axis direction negative output
01~08 (Output)	Output Ports 01 - 08, Active Low. Connect through the coil of a Relay, Solenoid, Lamp, or similar load to +24V.
01~16 (Input)	Activated by connecting to 0V via Relay Contacts or a Switch
AGND	Analog Spindle Output 0V
AO+	Analog Spindle Output. 0 to +10V DC
24V	System Power Supply Input Positive (+24V DC)
24G	System Power Supply 0V
V	I/O Power Positive (Connect to +24V Supply via a fuse)
G	I/O Power 0V

3. Connections: