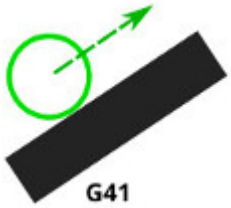
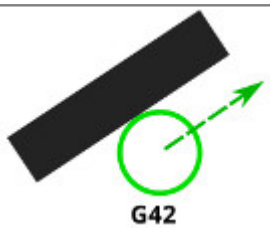
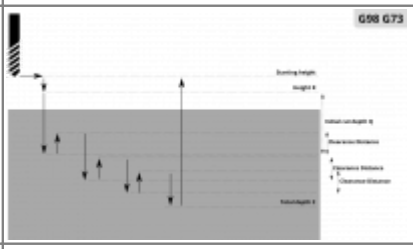
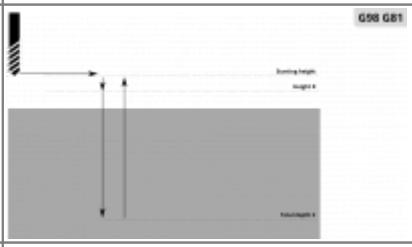
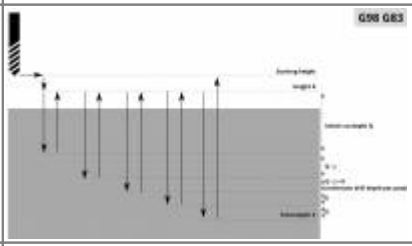
G-Codes list

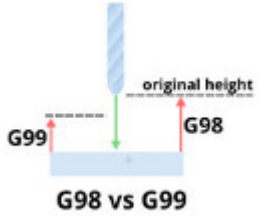
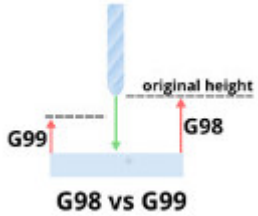
Below is a list of G-codes currently implemented in the myCNC system.

G-codes			
Code	**Description**	**Mill (M) Lathe(L) Cutting table (C)**	**Comments**
G00	Rapid Positioning		 . See note below on G53.
G01	Linear Interpolation		
G02	Arc CCW Interpolation		
G03	Arc CW InterpolatioMotion Mode Canceln		
G04	Dwell		In milliseconds. Will prevent the axes from moving during the specified time period
G5.1	~~Spline Interpolation~~		
G5.2	~~Nurbs Interpolation~~		
G5.3	~~Nurbs Interpolation End~~		
G10	Data Set		
G11	Mirror Cancel		
G12	Mirror X		
G13	Mirror Y		
G14	Mirror XY		
G15	Polar coordinates Off		
G16	Polar coordinates On		
G17	Plane XY		
G18	Plane ZX		
G19	Plane YZ		

G-codes			
Code	**Description**	**Mill (M) Lathe(L) Cutting table (C)**	**Comments**
G20	Set Units to Inches		
G21	Set Units to Metric		
G28	G28 Home		
G28.1	Home Position Set		
G28.2	Home Position #1 Save		
G28.3	Home Position #2 Save		
G28.4	Home Position #3 Save		
G28.5	Home Position #1 Restore		
G28.6	Home Position #2 Restore		
G28.7	Home Position #3 Restore		
G28.9	Home Position Address		
G30	G30 Home		
G30.1	G30 Home Set		
G33	Spindle Synchronization		
G33	Spindle Synchronization		
G38.2	G38.2 Probing		Probing codes G38.2-G38.5 are typically not used in myCNC systems, as their functions have been largely replaced and expanded by the PLC commands (specific probing M-codes)
G38.3	G38.3 Probing		
G38.4	G38.4 Probing		
G38.5	G38.5 Probing		
G38.9	Tool Measure		
G40	Tool Correction Cancel		
G41	Tool Correction Left		 YouTube link
G42	Tool Correction Right		
G43	G43 Tool Length Offset		
G44	G44 Tool Length Offset		

G-codes			
Code	**Description**	**Mill (M) Lathe(L) Cutting table (C)**	**Comments**
G49	G49 Cancel Tool Length Offset		
G50	G50 Scaling Cancel	M	
G51	G51 Scaling Set	M	
G50	G50 Set Max Spindle Speed (Lathe)	L	
G53	Machine Coordinates	M L	The toolpath planner (as well as the the line/circle interpolation commands) work only in program coordinates. Therefore, the G53 code only works with G0 positioning commands. See note below on G53 & G0 usage.
G54	Use Coordinate System #1	M L	Coordinate system switching codes G54-G59 change the offset between machine and work coordinates. As the toolpath planner does not have access to these commands, it is necessary to position the tool in the new coordinate system after switching (using G0)
G55	Use Coordinate System #2	M L	
G56	Use Coordinate System #3	M L	
G57	Use Coordinate System #4	M L	
G58	Use Coordinate System #5	M L	
G59	Use Coordinate System #6	M L	
G59.1	Use Coordinate System #7	M L	
G59.2	Use Coordinate System #8	M L	
G59.3	Use Coordinate System #9	M L	
G59	Set Hypertherm Power Source Parameters (Plasma Cutting table only)		
G61	~~Exact Stop~~	M	
G62	~~Corner Override~~	M	
G63	~~Mode Tapping~~	M	
G64	~~Mode Cutting~~	M	
G65	G-code macro	M	
G73	Cycle Deep Hole Drilling	M	
G74	Cycle Left Hand Tapping	M	
G76	Cycle Lathe Thread	L	G76 Thread Cycle
G80	Cancel Motion Mode		

G-codes			
Code	**Description**	**Mill (M) Lathe(L) Cutting table (C)**	**Comments**
G81	Cycle Drilling		
G82	Cycle Drilling Dwell		
G83	Cycle Peck Drilling		
G84	Cycle Right Hand Tapping		
G85	Cycle Boring No Dwell Feed Out		
G86	Cycle Boring Spindle Stop Rapid Out		
G87	Cycle Back Boring		
G88	Cycle Boring Spindle Stop Manual Out		
G89	Cycle Boring Dwell Feed Out		
G90	Absolute Programming		
G91	Incremental Programming		
G90.1	Arc Center Absolute Programming		
G91.1	Arc Center Incremental Programming		
G92	Set Work Position	M	
G92	Lathe Thread	L	For example, `G92 S3300` will set a max spindle speed of 3300 in the constant cutting speed mode
G94	Feedrate Per Minute	L	
G95	Feedrate Per Revolution		
G96	Lathe Surface Speed	L	Constant surface speed for a lathe with a given speed. For example, `G96 S220 M3` will set system to constant cutting speed mode at 220 units/min
G97	Set Spindle Speed	L	(revolutions per minute)
G98	Turn Feedrate per Minute	L	

G-codes			
Code	**Description**	**Mill (M) Lathe(L) Cutting table (C)**	**Comments**
G98	Canned Return Back to initial height	M	On mill machines, G98 allows to return the tool back to initial height Z during the canned return process. 
G99	Turn Feedrate per Revolution	L	
G99	Canned Return to a set height	M	As opposed to G98, which returns the tool to the initial height (height before cutting), G99 returns the tool to some set height Z. 
G130	Experimental feature - select a specific cutcharts mode from within a G-code program (for example, G130 P217 will select mode #217)		
G131	Cut on/off. The P parameter loads in different cutting modes.		G131 P0 - disable, G131 P1....16 - enable the corresponding mode. Power control (DAC-PWM) is activated accordingly per mode.
G150	Tool Correction Radius Set		
Miscellaneous M-codes			
Code	**Description**	**Implementation**	**Comments**
M00	~~Pause~~		
M01	Optional Stop	PLC	
M02	End Program	Native + PLC	
M03	Spindle On CW	PLC	
M04	Spindle On CCW	PLC	
M05	Spindle Stop	PLC	
M06	Change Tool	Macro	
M07	Mist On (Cutting On)	PLC	
M07	Plasma Dot Marking	PLC	
M08	Flood On (Cutting On)	PLC	
M08	Plasma table - Drill Marking	PLC	
M09	All Coolant Off (Cutting Off)	PLC	
M14	THC Off	Native + PLC	Cutting tables
M15	THC On	Native + PLC	Cutting tables

G-codes			
Code	**Description**	**Mill (M) Lathe(L) Cutting table (C)**	**Comments**
M19	Spindle Orientation On	PLC	Lathe
M20	Spindle Orientation Off	PLC	Lathe
M20	Start Cutting	PLC	Cutting Tables
M21	Stop Cutting	PLC	Cutting Tables
M23	Thread Finishing ON	PLC	Lathe
M24	Thread Finishing OFF	PLC	Lathe
M30	End Program with Rewind Pointer	Macro	
M41	Set Low Gears	PLC	
M41	Set High Gears	PLC	
M45	Start Plasma Marking	PLC	Cutting Tables
M46	Stop Plasma Marking	PLC	Cutting Tables
M50 (1)	THC Off	PLC	Cutting Tables
M50 (2)	Hypertherm HPR source Off On-the-fly	Native + PLC	Cutting Tables
M50 (3)	Feed Override On/Off	Native + PLC	
M51	THC On	PLC	Cutting Tables
M62	Turn On binary output pin	PLC	
M63	Turn Off binary output pin	PLC	
M64	Turn On binary output pin	PLC	
M65	Turn Off binary output pin	PLC	
M71	Start Cutting YouTube video	PLC	Cutting Tables
M72	Begin Plasma Marking Section	PLC	Cutting Tables
M73	End Plasma Marking Section	PLC	Cutting Tables
M74	Stop Cutting	PLC	Cutting Tables
M75-M88	User defined M-codes (Section 1)		
M92	Start Cutting	PLC	Cutting Tables
M93	Stop Cutting	PLC	Cutting Tables
M89	Start Marking	PLC	Cutting Tables
M90	Stop Marking	PLC	Cutting Tables
M98	Subroutine Run	Native	Cutting Tables
M99	Subroutine End	Native	Cutting Tables
M101-199	User defined M-codes (Section 2)		
M200-999	User defined M-codes (Section 3)		
M421	Tool Length Measure		
M422	Tool Breakage Check		
M440-M470	Probing tool macros (locating surface, edges, etc)		
Misc Macros			
Code	**Description**	**Implementation**	**Comments**

G-codes			
Code	**Description**	**Mill (M) Lathe(L) Cutting table (C)**	**Comments**
Homing			
M131	Homing X axis	Macro	
M132	Homing Y axis	Macro	
M133	Homing Z axis	Macro	
M134	Homing A axis	Macro	
M135	Homing B axis	Macro	
M136	Homing C axis	Macro	
M138	Homing All axes	Macro	

G10 Data Set

G10 L P Q X Y Z A B C U V W

- G10 - data set
- L - code operation
- P - Parameter #1
- Q - Parameter #2
- X,Y,Z,A,B,C,U,V,W - coordinates/values

1. **L2** - set an offset between program and machine coordinates. P1 to P9 for coordinate systems G54 to G59.3

```
G10 L2 P1 X1 Y1 Z1 (Set G54 offset X to 1, Y to 1, Z to 1)
```

2. **L70** - set position to given values
3. **P0** - Set **Machine Position** to given values

```
G10L70 P0 X0 Y0 (Set Machine coordinates X=0, Y=0)
```

4. **P1** - Set Work Position in **G54** Coordinates system to given values

```
G10L70 P1 X10 Y20 Z30 (Set G54/Work coordinates X=10, Y=20, Z=30)
```

```
G10L70 P1 X0 Y0 Z0 A0 B0 C0 (Set G54/Work coordinates
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

5. **P2** - Set Work Position in **G55** Coordinates system to given values

```
G10L70 P2 X0 Y10 Z20 (Set G55/Work coordinates X=0, Y=10, Z=20)
```

```
G10L70 P2 X0 Y0 Z0 A0 B0 C0 (Set G55/Work coordinates
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

6. **P3** - Set Work Position in **G56** Coordinates system to given values

```
G10L70 P2 X0 Y10 Z20 (Set G56/Work coordinates X=0, Y=10, Z=20)
```

```
G10L70 P3 X0 Y0 Z0 A0 B0 C0 (Set G56/Work coordinates
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

7. **P4** - Set Work Position in **G57** Coordinates system to given values

```
G10L70 P4 X0 Y10 Z20 (Set G57/Work coordinates X=0, Y=10, Z=20)
```

```
G10L70 P4 X0 Y0 Z0 A0 B0 C0 (Set G57/Work coordinates
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

8. **P5** - Set Work Position in **G58** Coordinates system to given values

```
G10L70 P5 X0 Y10 Z20 (Set G58/Work coordinates X=0, Y=10, Z=20)
```

```
G10L70 P5 X0 Y0 Z0 A0 B0 C0 (Set G58/Work coordinates
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

9. **P6** - Set Work Position in **G59** Coordinates system to given values

```
G10L70 P6 X0 Y10 Z20 (Set G59/Work coordinates X=0, Y=10, Z=20)
```

```
G10L70 P6 X0 Y0 Z0 A0 B0 C0 (Set G59/Work coordinates
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

10. **P7** - Set Work Position in **G59.1** Coordinates system to given values

```
G10L70 P7 X0 Y10 Z20 (Set G59.1/Work coordinates X=0, Y=10, Z=20)
```

```
G10L70 P7 X0 Y0 Z0 A0 B0 C0 (Set G59.1/Work coordinates
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

11. **P8** - Set Work Position in **G59.2** Coordinates system to given values
12. **P9** - Set Work Position in **G59.3** Coordinates system to given values
13. Current coordinates number is stored in Global variables register #5220. This register can be used to set Work coordinates in **the Current Coordinates System**

```
G10L70 P#5220 X0 Y10 Z20 (Set The Current Work coordinates X=0, Y=10,
Z=20)
```

```
G10L70 P#5220 X0 Y0 Z0 A0 B0 C0 (Set The Current Work coordinates to
X=0,Y=0,Z=0,A=0,B=0,C=0)
```

14. L80 - **Assign** value from **Q** to Register Address **P**

```
G10L80 P100 Q10 (//Assign "10" to Register #100 // #100=10 //)
```

15. L81 - **Copy** value from Register Address **Q** to Register Address **P**

```
G10L81 P100 Q10 (//Assign a value of Register #10 to Register #100 //
#100=#10 //)
```

16. L180 - **Add Q** value to Register Address **P** and store the result to Register Address **P**

```
G10L180 P100 Q10 (//Add 10 to Register #100 // #100=#100 + 10 //)
```

17. L181 - **Subtract Q** value from Register Address **P** and store the result to Register Address **P**

```
G10L181 P100 Q10 (//Subtract 10 from Register #100 // #100=#100 - 10
//)
```

18. L182 - **Mul** Register Address **P** by **Q** value and store the iresult to Register Address **P**

```
G10L182 P100 Q10 (//Multiply Register #100 by 10 // #100=#100 * 10 //)
```

19. L183 - **Divide** Register Address **P** to **Q**value and store the result to Register Address **P**

```
G10L183 P100 Q10 (//Divide Register #100 by 10 // #100=#100 / 10 //)
```

20. L184 - **Binary AND** value **Q** with Register Address **P** and store the result to Register Address **P**

```
G10L184 P100 Q66 (//Binary AND Register #100 with 66 // #100=#100 & 66
//)
```

21. L185 - **Binary OR** value **Q** with Register Address **P** and store the result to Register Address **P**

```
G10L185 P100 Q66 (//Binary OR Register #100 with 66 // #100=#100 | 66
//)
```

22. L186 - **Binary XOR** value **Q** with Register Address **P** and store the result to Register Address **P**

```
G10L186 P100 Q77 (//Binary XOR Register #100 with 77 // #100=#100 ^ 77
//)
```

23. L190 - **Add** value from Register Address **Q** with Register Address **P** and store the result to Register Address **P**

```
G10L190 P100 Q101 (//Add Register #100 with Register #101 // #100=#100
+ #101 //)
```

24. L191 - **Subtract** value from Register Address **Q** from Register Address **P** and store the result to Register Address **P**

```
G10L191 P100 Q101 (//Subtract Register #101 from Register #100 //
#100=#100 - #101 //)
```

25. L192 - **Mul** value from Register Address **Q** by Register Address **P** and store the result to Register Address **P**

```
G10L192 P100 Q105 (//Multiply Register #100 by Register #105 //
#100=#100 * #105 //)
```

26. L193 - **Divide** value from Register Address **P** to Register Address **Q** and store the result to Register Address **P**

```
G10L193 P100 Q101 (//Divide Register #100 to Register #101 // #100=#100
/ #101 //)
```

27. L194 - **ABS** calculate absolute value of Register Address **P** and store the result to Register Address **P**

```
G10L194 P100 (//Absolute value of Register #100 // #100=ABS(#100) //)
```

28. L200 - trigonometric functions support, a command with the format “P_reg1 Q_reg2” where Register Address reg1 = sin(reg2)

- L201 - reg1 = cos(reg2)
- L202 - reg1 = tan(reg2)
- L203 - reg1 = asin(reg2)
- L204 - reg1 = acos(reg2)
- L205 - reg1 = atan(reg2)

G92/G96 for lathe cutting

In a lathe system, G92 is used to set the maximum spindle speed (in the constant cutting speed mode), while G96 sets a constant surface cutting speed. In the code below,

```
N17 G97 S2500 M3
N18 G0 X14 Z1
N19 G92 S2500
N20 G96 S220 M3
```

the G92 line will set the maximum speed to 2500 rpm, while the G96 line will switch the system to a 220 m/min constant cutting speed mode.

In this mode, the spindle speed is recalculated depending on the current diameter (the current X coordinate).

The rotation speed changes depending on the diameter, so that the cutting tool moves along the surface at a set speed of 220 meters/min. The larger the diameter, the slower the system will rotate the part, and if the diameter is smaller, then the rotation speed will increase. By this logic, the rotation speed can go to infinity when the diameter reaches 0, so G92 is used to set a maximum value.

In a lathe configuration, both G92 and G50 work the same way if the “S” parameter is used. If the G92 command features an F-code parameter however, then the command is treaded as a threading command.

For example,

```
G92 S2500
```

and

```
G50 S2500
```

should produce the same result (although some users may prefer G92 due to the general convention). However, a command such as

```
G92 Z-12 X10 F1
G92 Z-12 X20 F1 L2 P99
```

is automatically recognized by the system as a threading command instead.

M07 - Plasma Dot Marking

M07 is used as Plasma Dot Marking. Dot Marking procedure is -

- Plasma Torch moves down till probe sensor activated
- The torch moves up to **Ignition Height**
- Plasma Power source is turned ON
- System wait Dot Time which is sum of **Plasma Power Source Delay Time** and **Dot Time**
- Plasma Power source is OFF
- Torch moves up to 20mm

M07 PLC procedure source code is below

M07.plc

```
#include pins.h
#include vars.h
#include func_ihc.h

main()
{
  portclr (OUTPUT_MARKER1);
  portclr (OUTPUT_MARKER2);

  do_plasma_probe();

  if (marker_ihc_dot_height<10) {marker_ihc_dot_height=10;}; //fix dot
height parameter is not correct

  gvarset(7080,ihc_move_down_speed);//set speed;

  g0moveA(0x0,0x4,marker_ihc_dot_height); //Z axis, ignition_height
  timer=200;do{ timer--; }while(timer>0); //wait 0.1sec till motion
started
  do { code=gvarget(6060); }while(code!=0x4d);//wait till motion
finished

  portset(OUTPUT_PLASMA); //PLASMA ON
  portset(OUTPUT_MARKER1);

  timer=marker_dot_time; //dot time
  timer=timer+marker_dot_delay; do{ timer--;}while(timer>0); //dot time
delay

  portclr(OUTPUT_PLASMA); //PLASM OFF
```

```
  portclr(OUTPUT_MARKER1);

  g0moveA(0x0,0x4,2000); //Z axis, ignition_height 20mm up
  timer=200;do{timer--;}while(timer>0); //pause 0.1sec for motion
starts
  do { code=gvarget(6060); }while(code!=0x4d);//wait till motion
finished

  proc=plc_proc_idle;
  exit(99);
};
```

M08 - Plasma cutting table - Drill Marking

M08 is used for Drill Marking operations on Plasma Cutting machines which have drill head. Drill Marking procedure is the following:

- Drill Head Cylinder and Drill Power turned ON
- Drill Head moves down on **Probing Speed** until **Drill probe sensor** activated
- Moving speed switched to **Drill Speed** and the Head move lower to programmed **Drill Depth**
- Drill Head moves up to **Lift Height**
- Drill Head Cylinder and Drill Power turned OFF

M08 PLC source code example is shown below

M08.plc

```
#include pins.h
#include vars.h
main()
{
  portset(OUTPUT_DRILL_VALVE);
  portset(OUTPUT_DRILL_POWER);

  gvarset(7080,drill_probe_speed ); //set speed;
  timer=200;do{timer--;}while(timer>0); //wait till drill head down

  sens=portget(INPUT_DRILL);
  if (sens==0)
  {
    g0moveA(0x0,0x4,0-30000); //Z axis
    timer=200;do{timer--;}while(timer>0); //wait till motion started
    do{
        code=gvarget(6060);
        sens=portget(INPUT_DRILL);
        if (sens!=0)
        {
          code=1;
          message=PLCCMD_LINE_STOP;//skip line
```

```
        };
      }while (code==0);
      do { code=gvarget(6060); }while(code!=0x4d); //wait till motion
finished
  };

  gvarset(7080,drill_speed);//set speed;
  if (drill_depth>50)
  {
    depth=0-drill_depth;
    g0moveA(0x0,0x4,depth);  //Z axis
    timer=200;do{timer--;}while(timer>0);   //wait till motion started
    do{code=gvarget(6060);}while(code!=0x4d);//wait till motion
finished
  };

  gvarset(7080,1000);//set speed up;

  if (drill_lift_height<100)
  {
    drill_lift_height=100;
  };

  g0moveA(0x0,0x4,drill_lift_height);   //drill head lift height
  timer=200;do{timer--;}while(timer>0); //wait till motion started
  do { code=gvarget(6060); }while(code!=0x4d); //wait till motion
finished

  portclr(OUTPUT_DRILL_VALVE);
  portclr(OUTPUT_DRILL_POWER);

  exit(99);
};
```

M45 - Start Plasma Marking

M45 - Start Plasma Marking is implemented through Hardware PLC procedure. The M45 source example is listed below. Functions should be described in include files “func_ihc.h” and “func_plasma.h”

- do_plasma_probe();
- do_move_ignition_height();
- do_wait_plasma();
- do_move_pcutting_height();

M45.plc

```
#include pins.h
```

```
#include vars.h
#include "func_ihc.h"
#include "func_plasma.h"

main()
{

    portclr (OUTPUT_MARKER1);
    portclr (OUTPUT_MARKER2);

    do_plasma_probe();
    do_move_ignition_height();

    portset(OUTPUT_PLASMA);
    portset(OUTPUT_MARKER1);

    do_wait_plasma();
    do_move_cutting_height();

    texit=timer+ihc_pierce_time;
    do{timer++;}while(timer<texit);

    start_thc();

    //set OK message and exit
    proc=plc_proc_plasma;
    message=PLC_MESSAGE_PLASMA_OK;
    exit(99);
};
```

G0G53 vs G1/G2/G3 commands

Keywords: Simulator Displacement Error, Critical Compiler Stop.

When using G0G53 commands in machine coordinates, the controller switches to the machine coordinate position and the program coordinates become undefined at that given moment as a result. This means that the G1/G2/G3 interpolation commands **cannot** be used under these circumstances (instead, G0 must be used).

Therefore, after such a switch, it is necessary to first give a positioning command using G0. This command must be given for those axes that were used as machine axes so that the controller can apply the appropriate offsets for the program coordinates.

For example, this issue will occur when a macro present within a G-code program will contain G0G53 commands (for instance, the M6 tool change macro), after which the G1/G2/G3 interpolation is used immediately. To go further with this example, the user CANNOT use the following combination:

```
M6T1 (in this example, M6 utilizes G0G53)
G1 Z5
```

```
G1 Y5 X5
```

The code above will lead to a simulator displacement error. Instead, for the example above, the following code must be used:

```
M6T1 (in this example, M6 utilizes G0G53)
G0 Z5
G0 Y5 X5
```

In this second code example, as the tool change macro uses G53 G0 XYZ, the first movement after a tool change will be G0 (for XYZ). This can either be done in G-code (via a post-processor which will correctly output G0 instead of G1 for that section), or within the tool change macro itself.