

Independent Axis ("AxisPlus")

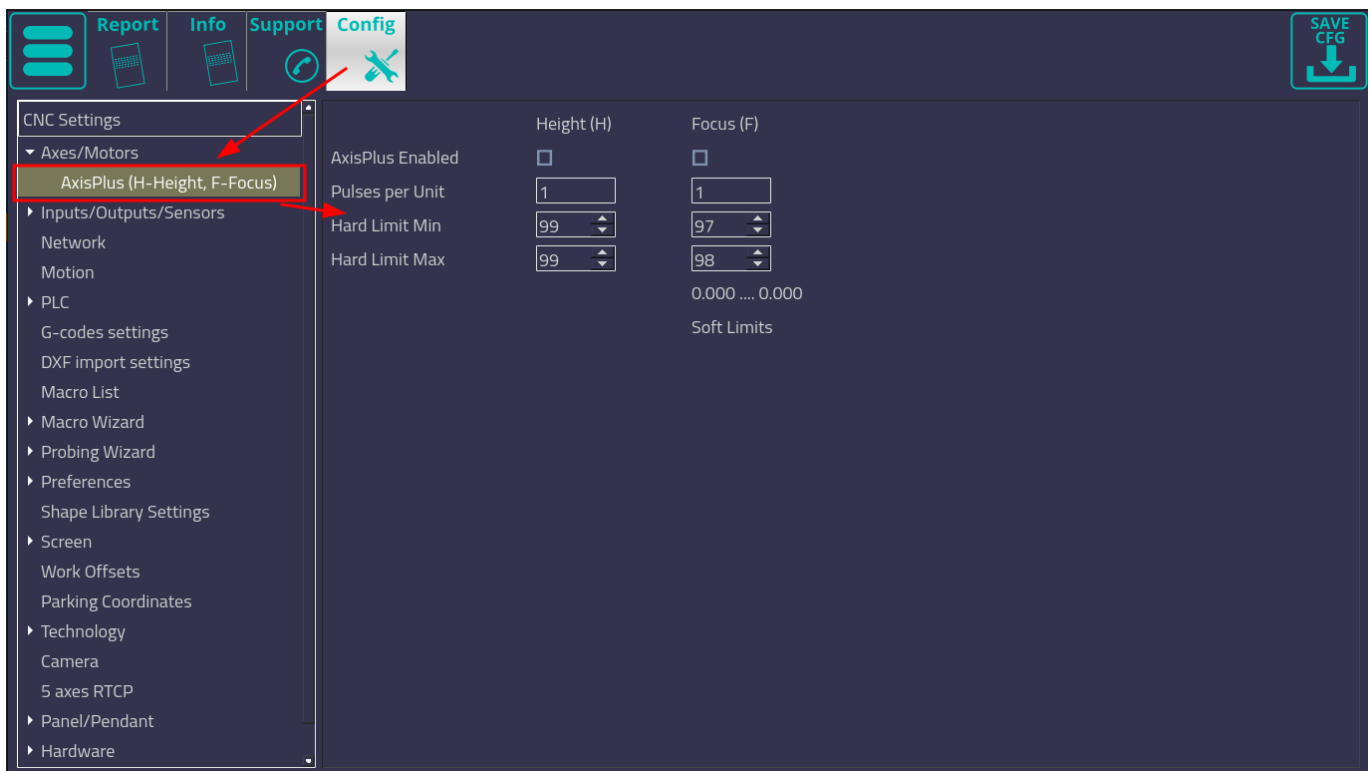


Article under construction (Feb 22 2024).

The AxisPlus settings window allows the user to utilize an additional independent axis using a myCNC controller to our software. Such an additional axis can be controlled simultaneously with (and independently of) the main program - this includes manual movements, MPG control and positioning instructions from within PLC commands.

This functionality useful for applications such as grinding machines, laser cutting (to have a Z-axis with tracking and positioning simultaneous with regular program execution), oxy-fuel cutting (piercing operations with simultaneous XY movement), and others.

AxisPlus settings for the Height and Focus axes are available in Settings > Config > Axes/Motors > AxisPlus:



Motors for axis H (height) and F (focus) must be attached in Settings > Config > Axes/Motors:

Enabled	Pulses per unit	Max Speed	Backlash	Axes mapping	Speed profile
X ☒	2123	1200	0	X	
Y ☒	2123	1200	0	Y	
Z ☒	2546	120	0	Z	
A ☐	1	0	0	A1 - rotation around X	Slave of XYZ
B ☐	1	0	0	B1 - rotation around Y	Constant surface speed
C ☐	1	0	0	Y	Slave of XYZ
U ☐		0	0	X	Slave of XYZ
V ☐		0	0	X	Slave of XYZ
Plus	2546	120	0	100	

Motor #0	Motor #1	Motor #2	Motor #3	Motor #4	Motor #5	Motor #6	Motor #7
Attach To Axis: H	X	Y	Y	H	H	F	V
Inversion: ☐	☐	☐	☒	☐	☐	☐	☐

These settings allow the operator to:

- Enable/disable the Height (H) and Focus (F) axes
- Set the pulses-per-unit values for either axis
- Set the input port number for the hardware limits (maximum and minimum)

(Note that the above configuration is an example only, real assignments for motors/axes will likely be different depending on the specific machine and setup).

Homing

Note that after a reset has been performed, the **soft limits are activated** to be equal to the current position. This is done to **prevent movement** in any direction for safety reasons. The software limit lock can be released by utilizing register 8522 (described in the table below). The recommended way to release the software limit lock is by running the homing procedure.

The code below is for M133 Automatic Z-axis Homing procedure:

M133.plc

```
#include pins.h

main()
{
    gvarset(5521,1); //Ignore Hard Limits
    gvarset(8522,999999); //Reset Soft Limits

    gvarset(5539,1);

    speed=gvarget(8044); //IHC_SPEED
    p=gvarget(8045); //SLOW_SPEED
```

```

slow_speed=speed*p/100;

gvarset(8341,speed); //Set Jog Speed
gvarset(8342,20);      //Set Jog Acceleration time 20ms = 0.02s

gvarset(8340,1);      //Jog Z+
do { sens=portget(INPUT_HOME_Z); }while(sens==0); //move up till
pressed

speed=speed>>2;
gvarset(8341,speed); //Set Jog Speed
gvarset(8342,20);      //Set Jog Acceleration time
gvarset(8340,0-1);      //Jog Z-, Slow speed
do { sens=portget(INPUT_HOME_Z); }while(sens!=0); //move down till
released

gvarset(8340,0); //stop
timer=60;do{timer--;}while(timer>0);

gvarset(8523,0); //AxisPlus Set MAX POS
timer=2;do{timer--;}while(timer>0);
gvarset(8522,0); //Set WORK ZERO(0)
timer=2;do{timer--;}while(timer>0);
gvarset(8524,0-5750); //AxisPlus Set MIN POS
timer=2;do{timer--;}while(timer>0);

exit(99);
};

```

The code below shows the M143 (Manual Z-axis Homing) procedure:

M143.plc

```

main()
{
    if (eparam==0)
    {
        gvarset(5521,1); //Ignore Hard Limits
        gvarset(8523,0); //AxisPlus Set MAX POS
        timer=2;do{timer--;}while(timer>0);
        gvarset(8524,0-5750); //AxisPlus Set MIN POS

        exit(99);
    };

    gvarset(5521,1); //Ignore Hard Limits
    gvarset(8523,0); //AxisPlus Set MAX POS
    timer=2;do{timer--;}while(timer>0);
    gvarset(8524,0-5750); //AxisPlus Set MIN POS

```

```

timer=2;do{timer--;}while(timer>0);
gvarset(8522,999999); //Reset Soft Limits (RELEASE Z AXIS)

exit(99);

};

```

Hardware Pendant settings window

Independent axis control can be enabled via the Hard Pendant settings window (as of myCNC v.1.88.4494).



NOTE: Pendant settings should be enabled if you'd like to utilize controller inputs as buttons for movement control. When an input assigned to a Hardware Pendant button is ON (meaning that the button has been pressed), the machine will move in +X (YZ), and when the button is released, the machine will stop.

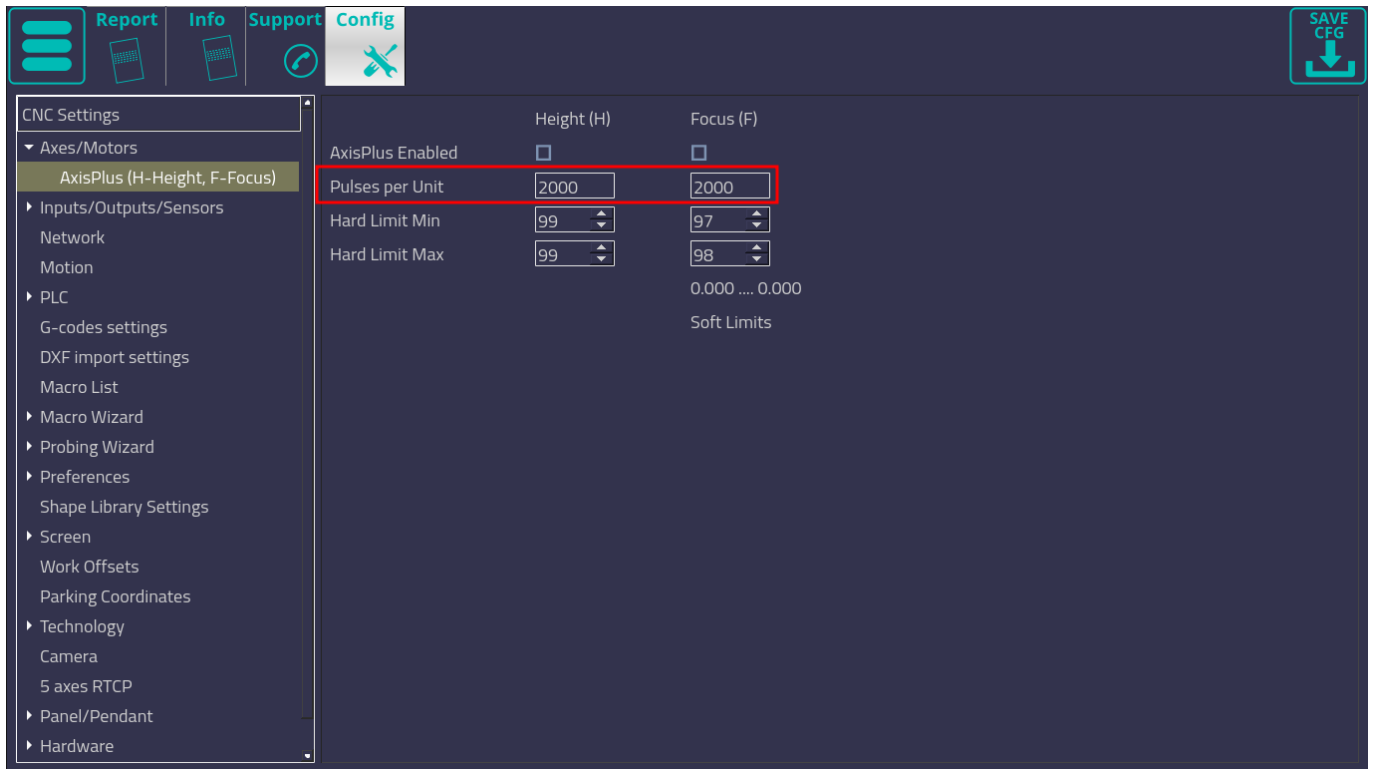
For this reason, it's not recommended to utilize the inputs specified in the Hard Pendant settings window for other additional purposes to avoid conflicts.

The screenshot shows the myCNC software interface with the 'Config' tab selected. The left sidebar lists various settings categories, and the 'Panel/Pendant' section is expanded. The 'AxisPlus Jog' checkbox is checked and highlighted with a red box, with the value '5' selected. Other settings include Jog X, Y, Z, A, B, C, Stop, Start, and MPG inputs.

To enable:

- Set the check mark next to **AxisPlus Jog** to ON
- Select the input port number for the pendant button. Select - 1 if no port is used.

To set the speed and acceleration for the independent axis, first head into Settings > Config > Axes/Motors > AxisPlus:



The units used are based on AxisPlus setting. Changing speed is done via writing to global variable 8341 (as shown in the code examples below). Instead of an acceleration value, an acceleration time is set in milliseconds:

```
gvarset(8342,100); //acceleration time 100ms = 0.1s
```

Jog control

Register	Access	Description
8341	Write	Set Jog Speed, [pulses/s]
8342	Write	Set Jog Acceleration, [1000* pulses/s ²]
8340	Write	Start/Stop Jog " 1" - Jog in positive direction "-1" - Jog in negative direction " 0" - Jog Stop
8343	Write	Set Soft Limit - (Minus)
8344	Write	Set Soft Limit + (Plus)

Position command (PLC)

Register	Access	Description
8330	Write	Set Positioning Speed, [pulses/s]
8331	Write	Set Positioning Acceleration Time, [msec]
8332	Read	Get AxisPlus State reading this register returns current state of the AxisPlus controller "0" - Idle state "1" - Positioning in action

Set Coordinate (PLC)

Register	Access	Description
9717	Write	Set Machine coordinate for AxisPlus, [pulses]

Other Global Variables

GVAR_CURRENT_AXPLUS_POSITION	5036	Current AxisPlus position coordinate
GVAR_CURRENT_FOCUS_POSITION	5037	Current Focus axis position coordinate
GVAR_FOCUS_STEP_PER_UNIT	8491	Step per unit value for the independent Focus axis
GVAR_FOCUS_G0_SPEED	8492	Focus axis - G0 speed
GVAR_FOCUS_G0_TIME	8493	
GVAR_FOCUS_MSPEED	8494	Jog (manual) speed
GVAR_FOCUS_MTIME	8495	Time to accelerate to jog (manual) speed, in ms
GVAR_FOCUS_SOFTMINUS	8496	
GVAR_FOCUS_SOFTPLUS	8497	
GVAR_FOCUS_JOG	8498	
GVAR_FOCUS_G0_STATE	8499	
GVAR_FOCUS_SET_ZERO	8502	
GVAR_FOCUS_SET_MAX_POS	8503	
GVAR_FOCUS_SET_MIN_POS	8504	
GVAR_FOCUS_HARDLIMITS	8505	
GVAR_AXPLUS_STEP_PER_UNIT	8511	
GVAR_AXPLUS_WPOSITION	8514	Get work position
GVAR_FOCUS_POSITION	8515	
GVAR_AXPLUS_LIFT	8516	
GVAR_FOCUS_LIFT	8517	
GVAR_AXPLUS_STOP	8518	
GVAR_FOCUS_STOP	8519	
GVAR_AXPLUS_SET_ZERO	8522	Writing 999999 to this register will reset the soft limits. Otherwise this allows to set a coordinate to a given value (in units of 1000 >1.000)
GVAR_AXPLUS_SET_MAX_POS	8523	If the value of this register is equal to zero, then current position is taken as the maximum position for the axis
GVAR_AXPLUS_SET_MIN_POS	8524	If the value of this register is equal to zero, then current position is taken as the minimum position for the axis
GVAR_AXPLUS_HARDLIMITS	8525	
GVAR_AXPLUS_MPOSITION	8526	Get machine position
GVAR_AXPLUS_JOGSPEED	8060	AxisPlus Jog Speed for the on-screen elements (as well as Page up/down button motion, pendant motion, etc)
GVAR_AXPLUS_DRO_SPEED	8701	AxisPlus speed display
GVAR_AXPLUS_DRO_DIR	8702	AxisPlus movement direction (1 for positive, -1 for negative, 0 for stationary). Can be used for LED indicators.
GVAR_FOCUS_DRO_SPEED	8711	Focus axis speed display
GVAR_FOCUS_DRO_DIR	8712	Focus axis movement direction (1 for positive, -1 for negative, 0 for stationary). Can be used for LED indicators.

A procedure "g0moveA()" is used to run AxisPlus positioning. A mask "0x1000" is used for AxisPlus

Code Example

```
gvarset(8330,40000); //G0PLUS SPEED - 40kHz pulses
gvarset(8331,500);   //G0Plus Time (Acceleration) - 0.5sec acceleration
time

g0moveA(0x0,0x1000,8000);           //Axis Plus - move 8000 pulses
do{ a=gvarget(8332); }while(a!=0); //Wait in a loop till motion is
finished

g0moveA(0x0,0x1000,0-8000);          //Axis Plus - move 8000 pulses in
negative direction
do{ a=gvarget(8332); }while(a!=0); //Wait in a loop till motion is
finished
```

Motion can be done via the global variable #8340, like in the following code:

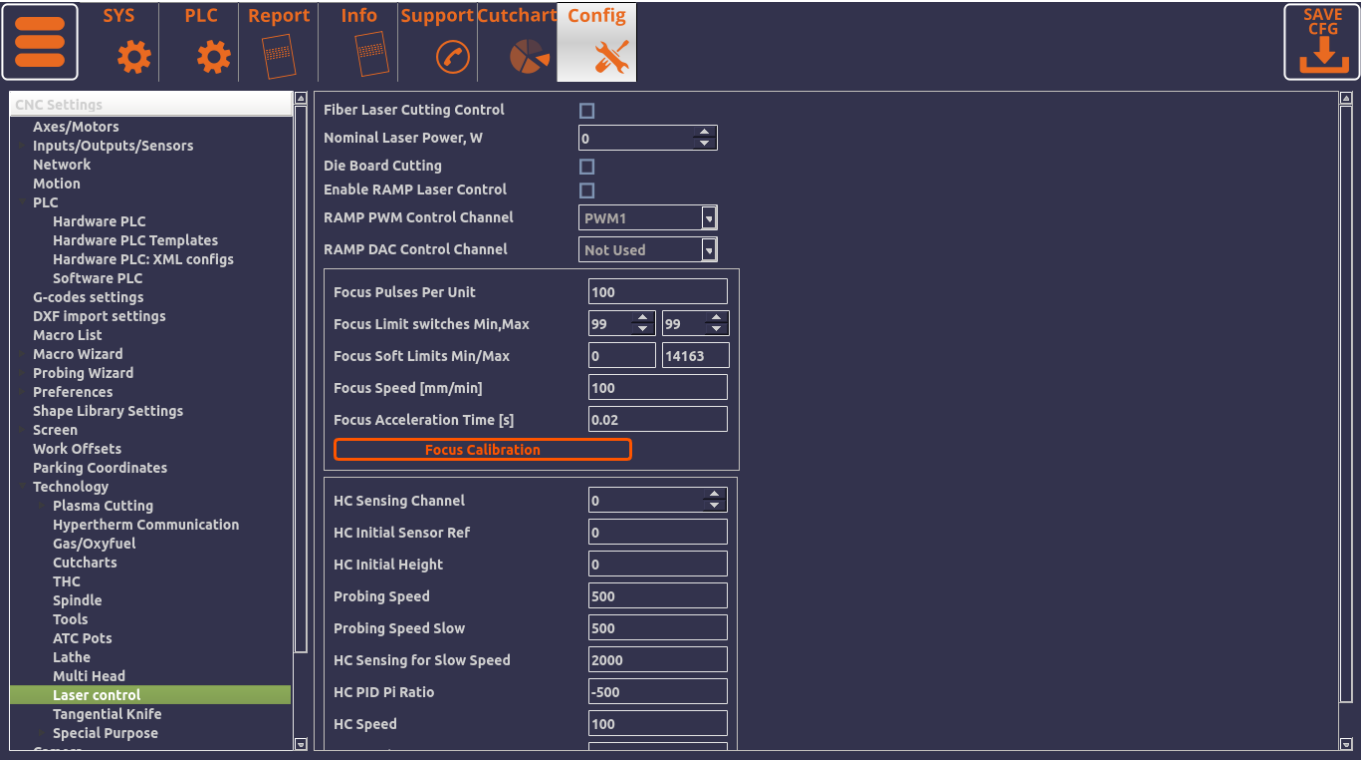
```
jog_plus()
{
  gvarset(8342,100); //acceleration time 100ms = 0.1s
  gvarset(8341,3000); //jog speed

  gvarset(8340,1); //JOG + direction
  timer=2000;
  do { timer--;
    if ((timer&0xff)==0) { gvarset(8340,1); };
    //repeat jog command every 0.256 sec to reset WatchDog.
    //If no repeat command, jog will be stopped after about 0.8 sec
  }while(timer>0);
  gvarset(8340,0-1); //JOG - direction
  timer=2000; do { timer--;
  if ((timer&0xff)==0) { gvarset(8340,0-1); };
  //repeat jog command every 0.256 sec to reset WatchDog.
  //If no repeat command, jog will be stopped after about 0.8 sec
  }while(timer>0);
  gvarset(8340,0);
```

The above code results in a 2 seconds long motion in the positive direction, which is then followed by a 2 seconds long motion in the negative direction. The axis motion is done at a speed of 3m/min with an acceleration set to be 0.1 seconds long.

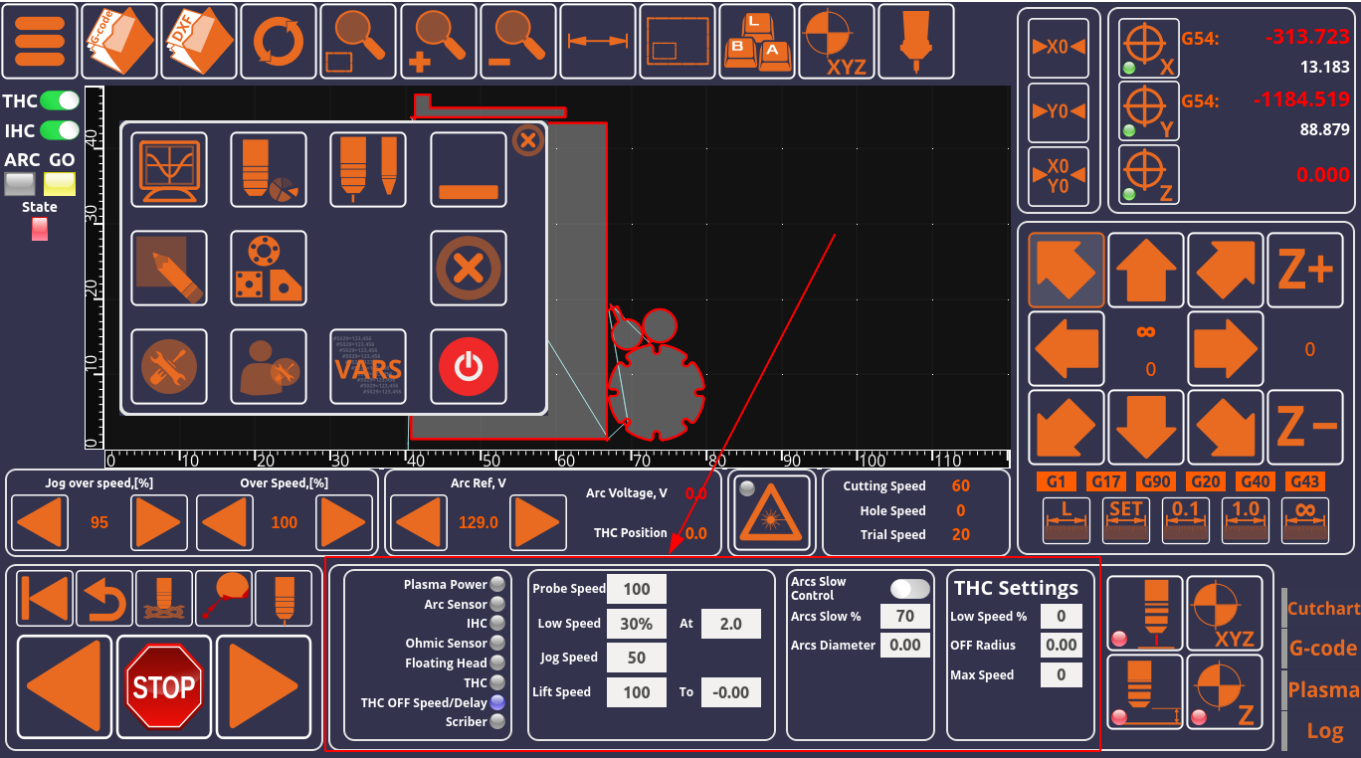
Focus axis

The Focus axis is similar to AxisPlus (for development purposes, the goal is to achieve parity between both of these independent axes). A number of Focus axis settings are available in the Technology → Laser Control tab:



Plasma cutting

The following settings are available for plasma cutting control in certain myCNC profiles (such as U1366P as of August 2022):



THC Control

THC control through the independent axis allows for two simultaneous THC systems to function for

two different axes on the same machine. The following variables are used for THC control with the independent axis:

9795	Independent axis - THC low speed percentage
9796	Independent axis - THC OFF arc radius
9797	Independent axis - THC max speed

Arc control

The following variables are used for arc slow control with the independent axis:

9790	Arcs slow control
7609	Arcs slow percentage (same gvariable as for typical Arc Control)
9791	Arcs slow diameter

Read more about arc slow control in general here: [MyCNC Configuration Dialogs - Plasma Settings](#)

PLC Examples

M71

The M71 PLC looks the following way:

[Show M71 code](#)

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

#include func_ihc_plus.h
#include func_plasma.h

main()
{

    portset(2); //TEMPORARILY!!!!

    speed_rapid=gvarget(7043);

    gvarset(5539,1);
    t=gvarget(5400);

    //  if (t!=1)
    //  {
    //      pos_x=gvarget(17001);
    //      pos_y=gvarget(17002);

    //      gvarset(5400,1); //change to plasma
    //      timer=100;do{timer--;}while(timer>0);
```

```
//      g0moveA(0x81,0x1,pos_x);//X axis set
//      g0moveA(0x81,0x2,pos_y);//Y axis set
//      g0moveA(0x81,0x0,0);      //XY move
//      timer=200;do{timer--;}while(timer>0);//wait till motion started
//      do { code=gvarget(6060); }while(code!=0x4d);//wait till motion
finished
//  };

plasma=gvarget(7184)&(1<<OUTPUT_PLASMA);
if (plasma!=0)
{
    message=PLC_MESSAGE_PLASMA_OK;    //set OK message and exit
    exit(99);
};

timeout_plasma_ready=10000;
timer=0;

do_plasma_probe();

do_move_ignition_height();

portset(OUTPUT_PLASMA);

do_wait_plasma();

do_move_pierce_height();

do_wait_pierce();

do_move_cutting_height();

start_thc();

start_trigger1();//Arc ON sensor
start_trigger2();//Collision Sensor

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

It includes the func_ihc_plus.h that is specifically designed for AxisPlus applications. That, in turn includes the following code blocks:

[do_plasma_probe](#)

```
do_plasma_probe()
```

```
{

a=gvarset(8332);
if (a!=0)
{ //Most likely lift process
  gvarset(8518,999999); //Cancel Lift
  do{ a=gvarset(8332);}while(a!=0); //wait till stop
};

gvarset(8048,2); //IHC Stage
timer=30;do{timer--;}while(timer>0);

gvarset(5539,1); //PLC Move Ver2
gvarset(8342,100); //acceleration time 80ms = 0.08s

speed=gvarset(8044);
gvarset(8341,speed);

p=gvarset(8045); //Slow speed %

slow_speed=speed*p/100;
slow_pos=gvarset(8046); //Position for slow speed;
slow_mode=0;

gvarset(8340,0-1); //Jog Z-

do
{

  pos=gvarset(8514); //get Current Position
  if (slow_mode==0)
  {
    if (pos<slow_pos)
    {
      gvarset(8342,100); //acceleration time 100ms = 0.1s
      gvarset(8341,slow_speed); //Set Slow Speed for Jog
      gvarset(8340,0-1); //
      slow_mode=1;
      gvarset(8048,1); //Change IHC Stage
    };
  };
  sens=portget(INPUT_IHC);
}while(sens==0);

gvarset(8340,0);

};
```

[do_move_ignition_height](#)

```
do_move_ignition_height()
{
    do{ a=gvarget(8332);}while(a!=0); //wait if Jog motion in progress

    //sens=portget(INPUT_FHS);
    //if (sens==0) { gvarset(8522, ihc_correction_height);} //FHS, offset
    //else { gvarset(8522, 0);} //Ohmic, zero offset
    //portclr(OUTPUT_PROBE);

    gvarset(8522, ihc_correction_height);

    gvarset(8330,speed_rapid); //AXPLUS Speed Positioning
    gvarset(8331,120); //AXPLUS Acceleration Time for Positioning

    g0moveA(0x1,0x80,ihc_ignition_height);//move Z+, ignition height
    do{ a=gvarget(8332);}while(a!=0);
};
```

[do_move_pierce_height](#)

```
do_move_pierce_height()
{
    g0moveA(0x1,0x80,ihc_pierce_height);//Z axis,
    do{ a=gvarget(8332);}while(a!=0);
};
```

and

[do_move_cutting_height](#)

```
do_move_cutting_height()
{
    g0moveA(0x1,0x80,ihc_cutting_height);//Z axis,
    do{ a=gvarget(8332);}while(a!=0);
};
```

M74

The M74 (end cutting) command contains the following code:

[Show M74 code](#)

```

#include pins.h
#include vars.h
#include func_plasma.h

main()
{

    stop_thc();
    stop_trigger1();

    //turn off power source
    portclr(OUTPUT_PLASMA);
    portclr(OUTPUT_PROBE);

    do_lift_after_cut();
    //start_trigger2();
    exit(99);
};

```

Here, it is the do_lift_after_cut section that contains the relevant AxisPlus components:

[do_lift_after_cut](#)

```

do_lift_after_cut()
{
    need_lift=1;

    if (proc!=plc_proc_plasma) { need_lift=0; };
    if (ihc_lift_after_cut<1) { need_lift=0; };
    a=gvarget(8332); if (a!=0) { need_lift=0; };

    if (need_lift!=0)
    {
        g0moveA(0x1,0x80,ihc_lift_after_cut);//Z axis,
        //do{ a=gvarget(8332);}while(a!=0);
    };
};

```

M133

M133 also features AxisPlus functionality with the global variables listed above:

[Show M133 code](#)

```

#include pins.h

main()

```

```
{

gvarset(5521,1); //Ignore Hard Limits
gvarset(8522,999999); //Reset Soft Limits

gvarset(8048,2); timer=30;do{timer--;}while(timer>0);
gvarset(5539,1);

speed=gvarget(8044);
p=gvarget(8045);
slow_speed=speed*p/100;

//gvarset(20010,speed); timer=30;do{timer--;}while(timer>0);

gvarset(8341,speed); //Set Jog Speed
gvarset(8342,80); //Set Jog Acceleration time 80ms = 0.08s

gvarset(8340,1); //Jog Z+

do { sens=portget(INPUT_HOME_Z); }while(sens==0);

speed=speed>>4;
gvarset(8341,speed); //Set Jog Speed
gvarset(8342,5); //Set Jog Acceleration time
gvarset(8340,0-1); //Jog Z-, Slow speed

do { sens=portget(INPUT_HOME_Z); }while(sens!=0);

gvarset(8340,0);
timer=20;do{timer--;}while(timer>0);

gvarset(8523,0);

exit(99);
};
```

Overall, the AxisPlus/Focus axes allow for the following advantages for laser/plasma cutting setups:

- allows to simultaneously change the cutting height along with XY movement, completely independently from each other
- allows the system to perform pierce operations while moving
- allows to lift the torch up after cutting while simultaneously repositioning the system (for instance, while moving to the next part - this functionality is sometimes labeled “Frog-Mode” by other systems)

Switching between AxisPlus and regular Z-axis

The following table lists the items that need to be switched within the myCNC software and the profile to change between the regular Z-axis control and AxisPlus (for instance, on a plasma setup):

Settings	Regular	AxisPlus
Config → Axes/Motors	Axes/Motors in settings - set to Z	Axes/Motors in settings - set to H
Homing	Uses the standard macro (described here)	Homing done via a custom PLC, regular homing macro must be DISABLED. See "Homing" section above.
Current Z-axis coordinate display	display-machine-pos-axis-2	display-cnc-gvariable-5036

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