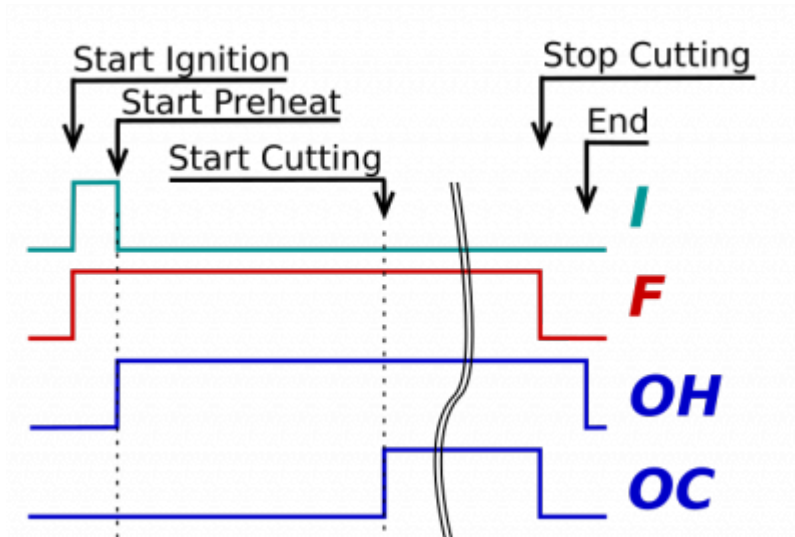


## Gas (Oxy Fuel) Cutting Control implementation.

Gas cutting control can be easily implemented on myCNC controllers through Hardware PLC.

### Simple Gas Cutting Control.



- I - relay for ignition unit
- F - Fuel valve
- OH - Preheat Oxygen valve
- OC - Cutting Oxygen valve

M71.plc

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

main()
{
    portset(OUTPUT_FUEL);           //turn ON fuel valve
    portset(OUTPUT_IGNITION);       //turn ON sparkle relay
    timer=timeout_ignition;
    do{ timer--; }while(timer>0); //delay for ignition

    portclr(OUTPUT_IGNITION);       //turn OFF sparkle relay
    portset(OUTPUT_OXY_HEAT);       //turn ON Preheat Oxygen valve
    timer=timeout_heating;
    do{ timer--; }while(timer>0); //pre-heating loop

    portset(OUTPUT_OXY_CUT);        //turn ON Cutting Oxygen valve

    exit(99);
};
```

myCNC software HMI has access to PLC variable **proc** and able to display its value on main screen. If update **proc** value with current status (Ignition/Preheat/Cutting/Purge) inside PLC procedure, then this status can be displayed on myCNC main screen

### M71.plc

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

main()
{
    portset(OUTPUT_FUEL);           //turn ON fuel valve
    portset(OUTPUT_IGNITION);       //turn ON sparkle relay

    proc=plc_proc_ignition;

    timer=timeout_ignition; do{ timer--; }while(timer>0); //delay for
    ignition

    portclr(OUTPUT_IGNITION);       //turn OFF sparkle relay
    portset(OUTPUT_OXY_HEAT);       //turn ON Preheat Oxygen valve

    proc=plc_proc_preheat;

    timer=timeout_heating;
    do{ timer--; }while(timer>0); //pre-heating loop

    portset(OUTPUT_OXY_CUT);        //turn ON Cutting Oxygen valve

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

How to add PLC process display to myCNC main screen [described here](#)

Relay numbers are defined in **pins.h**

### pins.h

```
#define OUTPUT_FUEL    6
#define OUTPUT_OXY_HEAT 7
#define OUTPUT_OXY_CUT 8
#define OUTPUT_IGNITION 5
```

Variable names are in **vars.h**

### vars.h

```
#define variable          var00
#define command           var00
#define parameter         var01

#define thc_enabled       var04
#define timeout_ignition  var05
#define timeout_heating   var06
#define ihc_pierce_time   var09
#define timeout_purge     var07
#define break_heating     var15
```

Time values for Ignition and heating are initialized in **plc-variables.xml**

[plc-variables.xml](#)

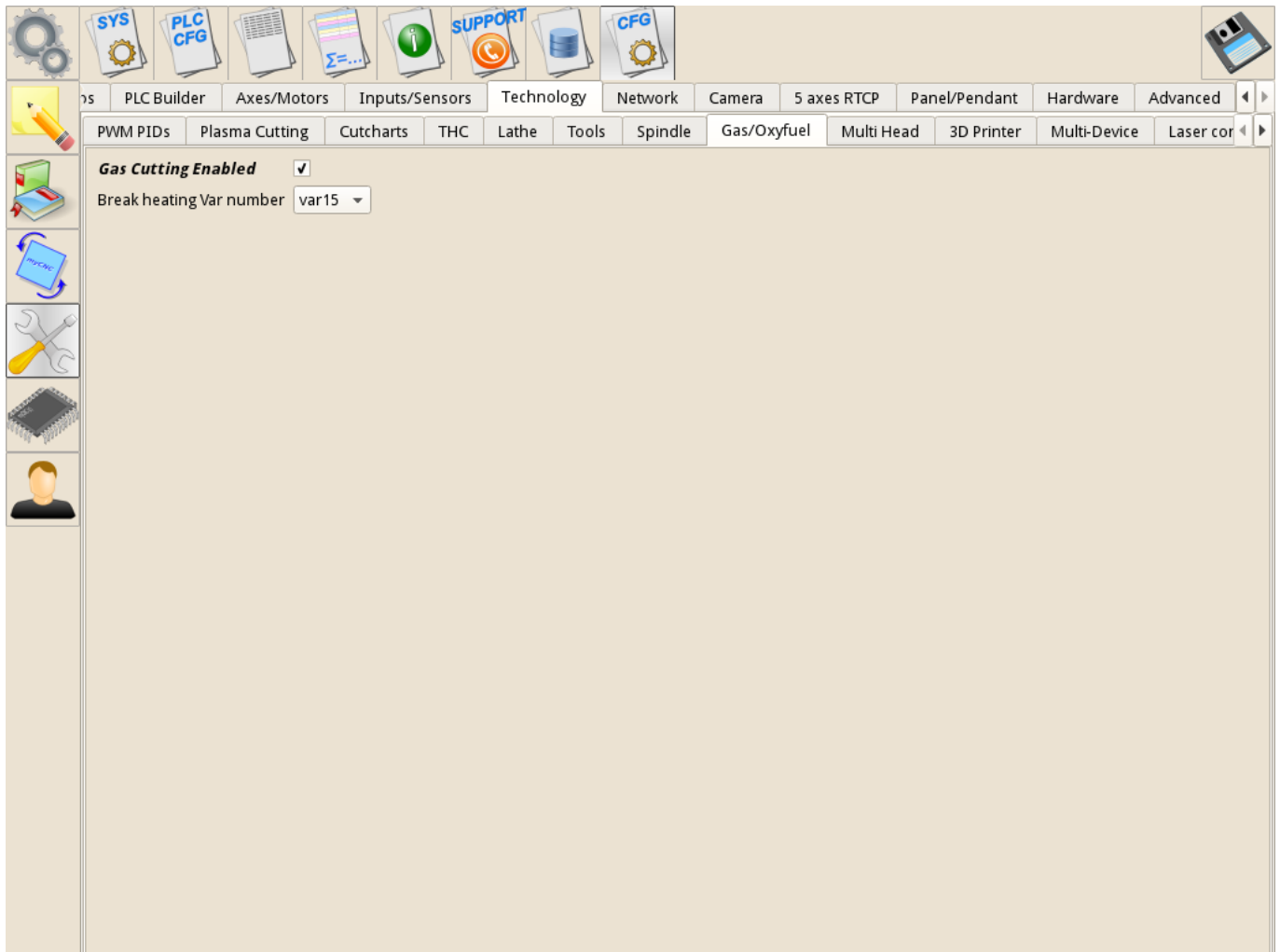
```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE CNC>
<plc-configuration version="1.0">
  <plc-function name="C07"
alias="M71;M07;M03;AIR;M401;M710;M151;C08;M74;M05;M02;OFF">
    <message>Oxy Fuel Cutting</message>
    <message_ru>Газовая резка</message_ru>
    <item>
      <value number="4" pname="plc-var-thc-enabled" type="radiobutton"
min="0" step="1"
max="1" text=";Off;On">1</value>
      <message>THC Enabled</message>
      <message_ru>Система слежения</message_ru>
      <message_kr>THC Enabled</message_kr>
    </item>
    <item>
      <value number="5" pname="plc-var-timeout-ignition"
type="numpad" min="0" step="5000"
max="10000">660</value>
      <message>Ignition time (Sparkle), ms</message>
      <message_ru>Время искры, ms</message_ru>
    </item>
    <item>
      <value number="6" pname="plc-var-timeout-preheat" type="numpad"
min="0" step="1000"
max="200000">5750</value>
      <message>Preheat time (Sparkle), ms</message>
      <message_ru>Время подогрева, ms</message_ru>
    </item>
    <item>
      <value number="7" pname="plc-var-timeout-purge" type="numpad"
min="0" step="100"
max="3000">1220</value>
      <message>Purge Time, ms</message>
      <message_ru>Время продувки, ms</message_ru>
```

```
</item>
<item>
  <value number="9" pname="plc-var-ihc-pierce-time" type="numpad"
min="0" step="100"
  max="10000">220</value>
  <message>Pierce Time,ms</message>
  <message_ru>Время пробивки,мс</message_ru>
</item>
</plc-function>
</plc-configuration>
```

## Cancel Pre-heat

Preheat procedure can take a long time (we often set 120 seconds for preheat). However if operator see metal sheet is warm enough to start cutting, he has an option to cancel preheat process immediately and start cutting by pressing a button.

Easy way - to press on-screen "Start" button. If myCNC software interface is configured for Gas cutting, myCNC software will reset PLC variable, defines in "Gas Cutting" configuration dialog as "break heating" variable.



in Start Cutting PLC procedure should be handler to monitor “break heating” variable and cancel Pre Heating if variable value is “0” -

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

portset(OUTPUT_FUEL);          //turn ON fuel valve
portset(OUTPUT_IGNITION);      //turn ON sparkle relay

proc=plc_proc_ignition;

timer=timeout_ignition; do{ timer--; }while(timer>0); //delay for ignition

portclr(OUTPUT_IGNITION);      //turn OFF sparkle relay
portset(OUTPUT_OXY_HEAT);      //turn ON Preheat Oxygen valve

proc=plc_proc_preheat;

break_heating=1;               //set break_heating variable
timer=timeout_heating;
do{ timer--;
if (break_heating==0)
{ timer=0; }; //If break_heating was cleared outside of PLC, clear
timer to exit from the loop
}while(timer>0);               //pre-heating loop

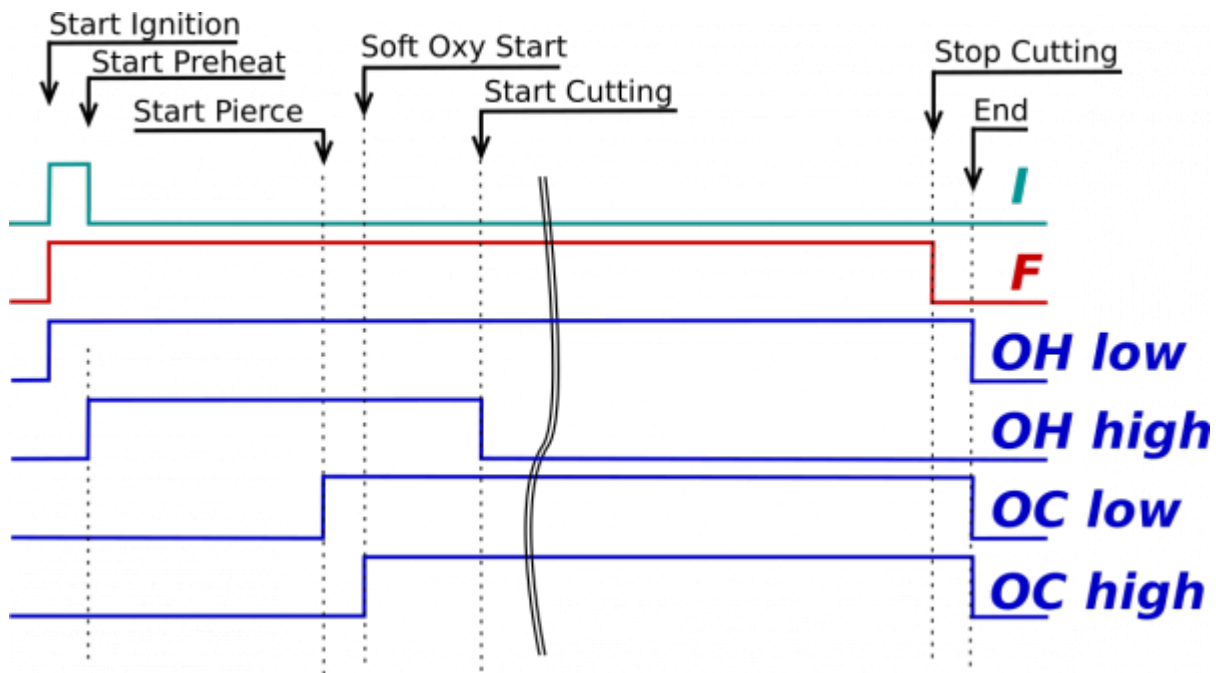
portset(OUTPUT_OXY_CUT);       //turn ON Cutting Oxygen valve

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

## 6 valves Gas Cutting Control

More complicated Gas Cutting control contains 6 valves

- I - Ignition
- F - Fuel
- OH Low - Preheat Oxygen Low Pressure
- OH High - Preheat Oxygen High Pressure
- OC Low - Cutting Oxygen Low Pressure
- OC High - Cutting Oxygen High Pressure



Start Gas Cutting procedure is simple sequence of following steps -

- Ignition (turn on valves for ignition), wait ignition time;
- Preheat (turn on valves for preheat), wait preheat time, cancel preheat if "break\_heating" variable was reset;
- Cutting Oxygen soft start (turn on Cutting Oxygen Low pressure valve), wait soft start time;
- Pierce start (turn on Cutting Oxygen High pressure valve), wait pierce time;
- Turn off Oxygen Heat Hi pressure to come to soft cutting mode.

Source code is -

### M03.plc

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

main()
{
    portset(OUTPUT_FUEL);           //On Valves for ignition
    portset(OUTPUT_IGNITION);
    portset(OUTPUT_OXY_HEAT_LO);
    proc=plc_proc_ignition;

    timer=timeout_ignition;         //Set Ignition process
    do{ timer--; }while(timer>0); //wait ignition

    portclr(OUTPUT_IGNITION);
    portset(OUTPUT_OXY_HEAT_HI);
    proc=plc_proc_preheat;

    break_heating=1;
    timer=timeout_preheat;
```

```

do{
timer--;
if (break_heating==0) { timer=0; };
}while(timer>0);           //heating loop

portset(OUTPUT_OXY_CUT_LO); //add Oxy Cutting Lo pressure
timer=timeout_soft_start;
do{ timer--; }while(timer>0); //wait for Soft Oxy start

portset(OUTPUT_OXY_CUT_HI); //add Oxy Cutting Hi pressure

timer=ihc_pierce_time;
do{ timer--; }while(timer>0); //wait for Pierce

portclr(OUTPUT_OXY_HEAT_HI); //add Oxy Cutting Hi pressure

if (thc_enabled!=0)
{
    command=0xa4; //Start Height sensing
    parameter=1;
    message=PLCCMD_SET_CNC_VAR;
    texit=timer+3; do{timer++;}while(timer<texit);
};

proc=plc_proc_cutting;

exit(99);
};

```

In “Stop Cutting” procedure all the valves should be turned OFF. However due to slow flow speed of fuel gas a loud swat is possible while valves closed. It's useful to purge the gun with Oxygen for about 1-2 secs.

Stop Cutting PLC procedure with purge is shown below -

#### M05.plc

```

#include pins.h
#include vars.h

main()
{
    portclr(OUTPUT_FUEL);           //Off Valves
    portclr(OUTPUT_IGNITION);
    portclr(OUTPUT_OXY_HEAT_HI);
    portclr(OUTPUT_OXY_CUT_LO);
    portclr(OUTPUT_OXY_CUT_HI);

    if (proc==plc_proc_cutting)

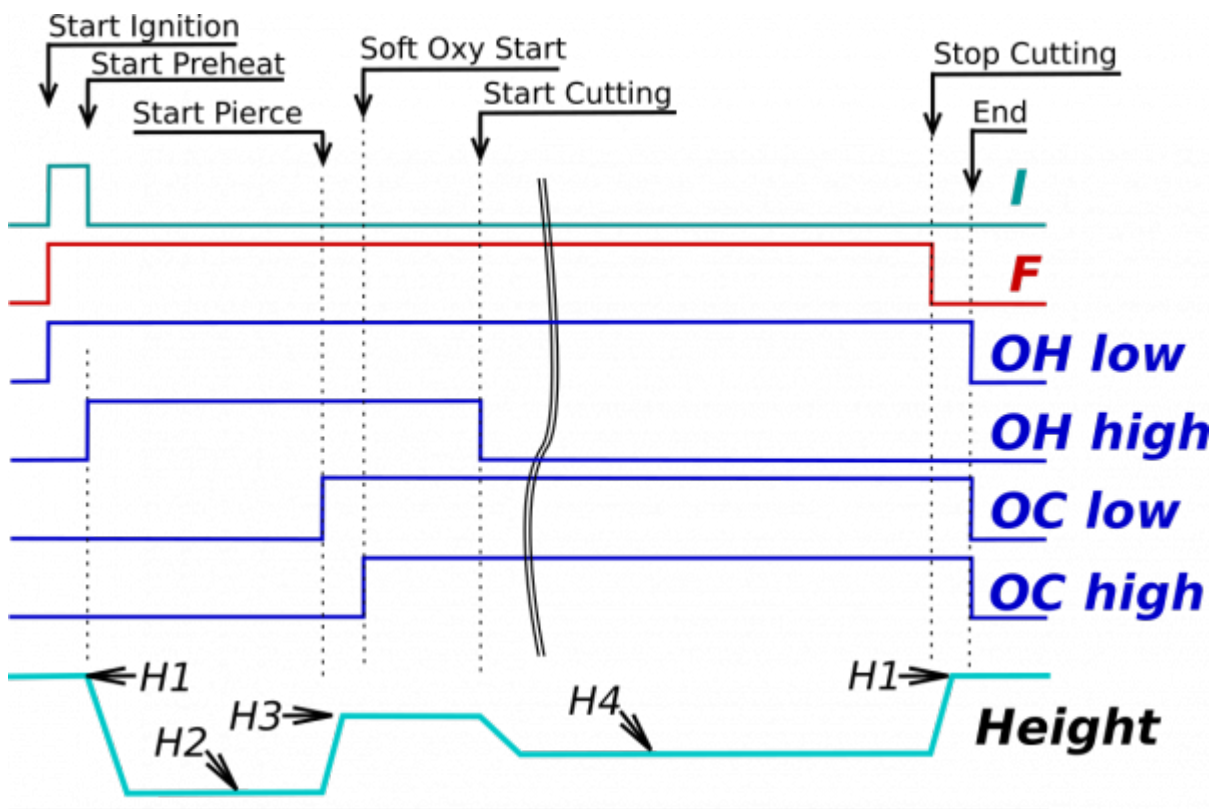
```

```
{
    portset(OUTPUT_OXY_HEAT_L0);
    timer=timeout_purge;          //Set Ignition process
    do{ timer--; }while(timer>0); //wait ignition
};

portclr(OUTPUT_OXY_HEAT_L0);    //
command=0xa4; //Stop Height sensing
parameter=0;
message=PLCCMD_SET_CNC_VAR;
timer=2; do{timer--; }while(timer>0);

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

## Gas Cutting Control with Initial Height positioning



- H1 - Safe Height, defined as distance from cutting height at the end of previous cut. Ignition process started on Safe Height. A system waits 1-2 seconds for stable flame process, then switch to Preheat Process and moves torch down to -
- H2 - Preheat Height - defined by Capacitory Height Sensor value. After Preheat process finished, valves switched to "Start Pierce" and torch moved to
- H3 - Pierce Height defined as distance from preheat height. After Pierce is finished, Cutting and toolpath motion started, THC is activated and torch moved down by Torch Height Control to
- H4 - Cutting Height, defined as Torch Height Control Reference value.



## M03.plc

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

main()
{
    portset(OUTPUT_FUEL);           //On Valves for ignition
    portset(OUTPUT_IGNITION);
    portset(OUTPUT_OXY_HEAT_LO);
    proc=plc_proc_ignition;

    timer=timeout_ignition;         //Set Ignition process
    do{ timer--; }while(timer>0); //wait ignition

    portclr(OUTPUT_IGNITION);
    portset(OUTPUT_OXY_HEAT_HI);
    proc=plc_proc_preheat;

    break_heating=1;
    timer=timeout_preheat;

    gvarset(7080,2000);             //setup Z axis Speed
    h=0-30000;
    g0moveA(0x0,0x4,h);             //Z axis, move down
    do{ timer++; }while (adc01<ihc_preheat_height);
    //wait in the loop till Current Height from Height Sensor (adc01)
    //less than given value of ihc_preheat_height;
    //then stop motion and continue preheat process

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

    do{ timer--;
    if (break_heating==0) { timer=0; };
    } while(timer>0);               //heating loop

    portset(OUTPUT_OXY_CUT_LO);     //add Oxygen Cutting Lo pressure

    gvarset(7080,2000);
    g0moveA(0x0,0x4,ihc_pierce_height); //Z axis, move up
    timer=100; do{ timer--; }while (timer>0);
    //after 0.1sec delay motion is definitely started
    do { timer++;code=gvarget(6060); }while(code!=0x4d);
    //then ait till motion finished

    timer=timeout_soft_start;
    do{ timer--; }while(timer>0); //wait for Soft Oxygen start

    portset(OUTPUT_OXY_CUT_HI);     //add Oxygen Cutting Hi pressure
```

```
timer=ihc_pierce_time;
do{ timer--; }while(timer>0); //wait for Pierce

portclr(OUTPUT_OXY_HEAT_HI); //add Oxy Cutting Hi pressure

if (thc_enabled!=0)
{
    command=0xa4; //Start Height sensing
    parameter=1;
    message=PLCCMD_SET_CNC_VAR;
    texit=timer+3; do{timer++;}while(timer<texit);
};

proc=plc_proc_cutting;

exit(99);
};
```

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