

# Getting started guide for your first EDM cut



Document version 2.0

## Introduction

This document helps you getting started for making your first cut with your custom wire EDM machine. The example settings will cut a 5mm thick piece of aluminum.

## Prerequisites

- You have build your own wire EDM machine that uses LinuxCNC for the CNC control.
- The machine uses the BX18 BaxEDM arc generator
- The machine uses the BaxEDM C-arc controller, connected though a FTDI USD to RS-485 cable to the Linux PC
- Software has been installed according to:  
<https://baxedm.com/linuxcnc-installation-for-edm-machine/>
- The machine uses ECT60 drives for the stepper motors and IO for the peripheral control. The IO of the drives should be connected according to:  
[https://www.baxedm.com/wp-content/uploads/2023/06/Control\\_Cabinet\\_Schematic.pdf](https://www.baxedm.com/wp-content/uploads/2023/06/Control_Cabinet_Schematic.pdf)

## Checklist prior to making your first cut

Before you attempt to make your first cut, please make sure to run through the following checklist:

1. Make sure that after starting up and homing your axes in LinuxCNC, you can move the axes manually with the arrow keys on your keyboard.
2. On the BaxEDM tab, subtab “Arc generator”, click on “EDM on”, the Arc generator should turn on (warning light output activates and the fan comes on).
3. With EDM on, go to the “Automatic Feedrate Control” tab. Make sure the EDM wire is not touching anything, the field “Actual Generator Feedback” should now show a live value of approximately 4000. You can now go back to the “Arc generator” tab and turn the generator off with the “EDM off” button.
4. Go to the “Wire Control” subtab. Tryout if you can turn the wire chopper on and off, with the buttons named accordingly.
5. With the wire chopper on, turn on the wire transport with the button labled “Run wire”. The wire speed should slowly ramp up. When at transport speed, feel if the wire is tensioned properly. Note that the tension strength can be adjusted in your G-code. We are now just

- checking if everything behaves normally.
6. When the wire is running normally, cut it to test a wire break condition. When cut, the red indicator labeled “Wire NOK/break indicator” on the subtab “Wire Control” should come on and both wire transport servos should stop immediately. After this, re-thread the EDM wire and run it for a short while to check if everything is ok and good to go.
  7. Now go to the subtab “water management”. Tryout the buttons for filling the tank. Fill the tank until the top flushing nozzle of the C-arc is completely submerged. Now tryout the buttons for flushing the work.

## **G-codes for EDM specific machine control**

All actions required to get the machine going for making a cut are under G-code control and can thus be automated. As an example, lets have a look at the header of the G-code for the example file of the BaxEDM logo:

```
M52 P1; enable dynamic feedrate control
M117 P3 Q27; set the arc generator pulse timing
M118 P14; set the arc current
M131; start workpiece flushing
G4 P10.0; Wait for the flush pump flow to ramp up
M124 P6 Q20; configure the wire speed and tension
G4 P0.1; Always wait 100 milliseconds after configuring the wire tension and speed
M125; start running the wire
M127; turn the wire chopper on
G4 P5.0; Wait for the wire to get up to speed
M120; enable the arc
F50; set the feedrate to 50, automatic feedrate control does the rest (when enabled)
```

### ***M52 P1***

This line enables the BaxEDM software to overwrite the feedrate dynamically, which is essential for EDM feedrate control. M52 should always be active. It can also be deactivated with the G-code M52 P0. That will disable feedrate control.

### ***M117 P3 Q27***

This line configures the arc generator on-time to 3 us and the off-time to 27us. This setting is used to cut 5mm thick aluminum as an example.

### ***M118 P14***

This line sets the arc current to 14A. This is a level suitable for cutting 5mm thick aluminum.

### ***M131***

This command starts the work flushing pump. Make sure that the tank is filled enough before starting to flush the work.

### ***G4 P10.0***

This is a pause of 10 second, allowing the work flushing pump to ramp up and get a stable constant

flush going.

### **M124 P6 Q20**

This line sets the wire speed to 6m/min and the tension to 20N. After running this command wait at least 100ms to allow the C-arc controller to process the change before sending new commands.

### **G4 P0.1**

Wait 100ms to allow the C-Arc controller to process the the command

### **M125**

Command the C-arc controller to start running the wire

### **M127**

Start the wire chopper

### **G4 P5.0**

Wait 5 seconds to give the C-arc controller enough time to ramp up to steady speed.

### **M120**

Start the BX18 arc generator

### **F50**

Set the feedrate.

Note! : The numbers in this section are referenced to metric units.

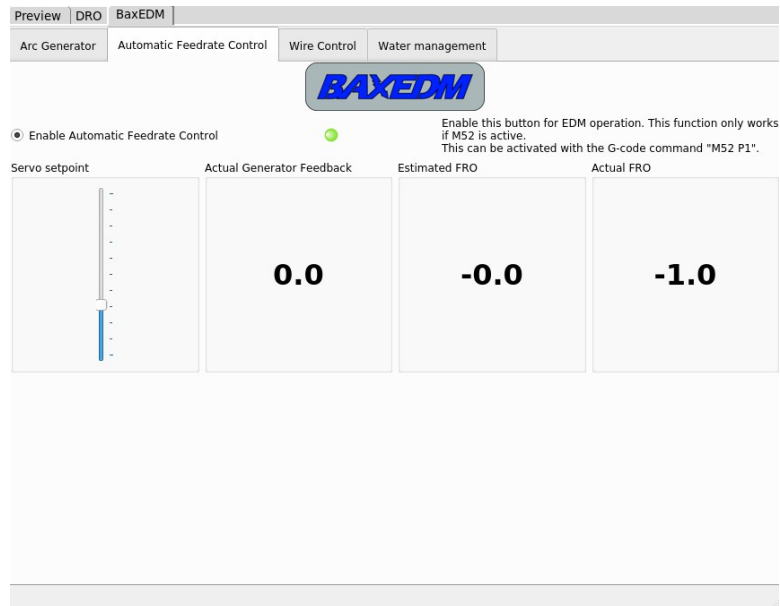
Although the software automatically determines the best feedrate during EDM cutting, it is still necessary to provide the feedrate. The feedrate provided is the maximum feedrate at which the machine can cut. This number is forgiving but it needs to be in the same order of magnitude as the actual/expected number. Almost all thin materials can be cut with F50. For very thick materials of which a cutting speed of less than 5mm/min can be expected the feedrate should be set to F5.

If a too high feedrate is chosen, the cutting speed control loop will show cyclic jerky behavior, where the wire bounces into the work and back trying to find the optimal speed.

If a too low feedrate is chosen, the EDM feedrate will max out, cutting at less than optimal speed, which wastes time.

# Automatic Feedrate Control explained

The Automatic feedrate control subtab looks like this:



## When to enable/disable control?

The subtab “Automatic Feedrate Control” is used to enable or disable the automatic feedrate control. For almost all EDM cuts, automatic feedrate control should be enabled. For EDM skim / fine finishing passes, the control can be disabled to simply skim the part at a fixed rate.

## How to set the servo setpoint?

The servo setpoint sets how aggressively the automatic feedrate control algorithm tries to push the wire through the part. To higher you slide the slider the faster the algorithm tries to cut. When the slider is too low, you will cut at a suboptimal speed. When the slider is too high, the stability of the cut is poor, causing “stutter” in the arc and jerky movement of the X & Y motors. At the right level, the cut is stable, with an occasional twitch of the servos/feedrate. A good starting point is the 3<sup>rd</sup> or 4<sup>th</sup> tick from below.

## Automatic Feedrate DROs explained

The subtab “Automatic feedrate control” shows 3 DROs (digital readouts). The first DRO, “Actual generator feedback” displays the live number that represents the arc generator feedback. Above about 4000 this indicates that there is no arc. Anything below 800 can be considered a shortcut. The number is in the ~4000-800 window during normal EDM operation.

The DRO labeled “Estimated FRO” is the feedrate estimation of the feedrate algorithm for the optimal cut for the given servo setpoint. This number lies somewhere between 0 and 1, where 1 is the feedrate as given by the FXX G-code command. If this number is 0.5, this means that the estimated cutting feedrate is half that of the feedrate in the G-code.

The DRO labeled “Actual FRO” is the actual feedrate overwrite factor. When multiplied by the feedrate in the G-code this gives the actual live feedrate being used.

During normal EDM operation the estimated FRO and actual FRO should be nearly identical on average. The difference is that the actual FRO will jump around more. This is the control at work,

which is a dynamic process that quickly and continuously acts on all sorts of arcing and flushing conditions.

The jumping/glitching of the actual FRO number is greatly affected by the servo setpoint slider. If there are too frequent jumps (e.g. every second or faster), reduce the slider. Every 5-10 seconds is ok.

In the preview screen of LinuxCNC, you can see the actual resulting feedrate. It should be quite stable if the part thickness does not vary.

## Making the first cut

For the first cut, let's cut a 5mm thick piece of aluminum. Place the stock material into the machine and position the wire to the left of the stock with your arrow keys with LinuxCNC in manual mode. The wire must not touch the stock. Leave 1-2mm between. Fill the water tank to completely submerge the work and upper flushing nozzle.

Go to the "Automatic feedrate control" subtab, and enable the control, making sure the light is green. Then set the slider to the 4<sup>th</sup> tickmark.

Now run the following code to make a cut 20mm long along the X axis in the positive direction:

M52 P1; enable dynamic feedrate control

M117 P3 Q27; set the arc generator pulse timing

M118 P14; set the arc current

M131; start workpiece flushing

G4 P10.0; Wait for the flush pump flow to ramp up

M124 P6 Q20; configure the wire speed and tension

G4 P0.1; Always wait 100 milliseconds after configuring the wire tension and speed

M125; start running the wire

M127; turn the wire chopper on

G4 P5.0; Wait for the wire to get up to speed

M120; enable the arc

F50; Set the feedrate to 50, automatic feedrate control does the rest (when enabled)

X20; Cut into the part

X0; Move back through the cut

M121; arc off

M132; stop work flushing

M126; stop wire

M128; stop wire chopper

M30;

Automatic G-code execution goes fast. For the first time it might be wise to run the lines one by one so that if something does not go as planned, you can see at which point this happens. This helps to find the problem.

Good luck with your first cut!