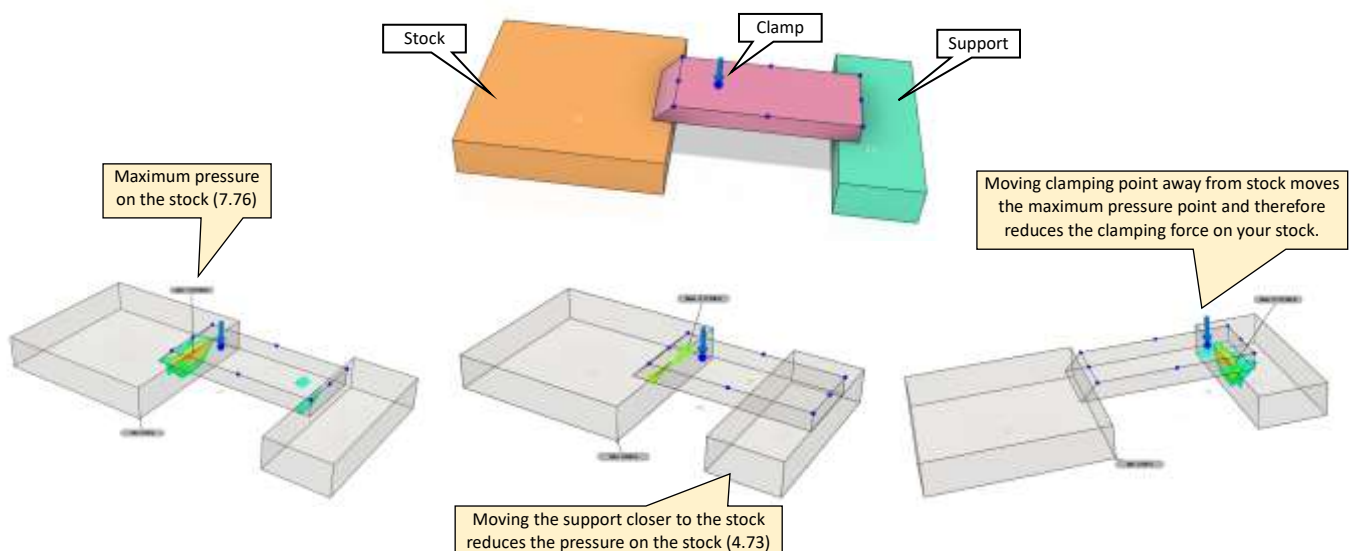## Key Points

- Safety First – wear eye and hearing protection and use the dust extractor.
- Don't leave loose objects on the machine bed.
- Align and clamp stock properly.
- Always Home the machine before starting a new job.
- Be careful to avoid the clamps when moving the spindle.
- An Air Cut can reduce the risk of cutting into the machine bed.
- `+z` = ↑   `-z` = ↓   `g28` = Home   `m30` = End Program
- `g0x0y0z0` = Move to your Work Origin

Safety and Risks

- The CNC is a fast moving, noisy machine with a very sharp bit spinning at high speeds and cutting into material that can dislodge or have pieces flying off. It also creates a lot of wood dust.
- Eye and hearing protection is a must.
- Make sure the extractor fan is running when cutting.
- Always ensure the spindle and gantries are free to move.
- Keep loose objects off the machine bed.
- Be aware that the extractor will suck objects lying on the table, including pieces of paper and USB sticks.
- Consider the risks associated with an Air Cut (see further detail below).
- Consider the possibility of bad scenarios:
    - The machine could move unexpectedly.
    - A bit can break off or drop out of the spindle.
    - Your stock could dislodge, or pieces can break off.
- Always be ready to hit the emergency stop button.

Preparing the Stock

1. Ensure you stock contains a reference point. Typically, this is in the centre and on the top of your stock and must align with what you have set up in your model.
2. Use sacrificial wood if cutting through the stock.
3. Ensure the stock is lined up correctly (parallel with each **x** and **y** axis).
4. Think about good ways to clamp. Using timber underneath will give a better hold. Watch the edge rail as it pops up. Ensure clamps won't be hit when the spindle moves by using the appropriate length screw rod.

Stock | Clamp | Support

Maximum pressure on the stock (7.76)

Moving clamping point away from stock moves the maximum pressure point and therefore reduces the clamping force on your stock.

Moving the support closer to the stock reduces the pressure on the stock (4.73)

Preparing the Machine

5. Use the Supervisor supplied key to turn the machine on.
6. Clear the emergency stop if the `Ready` button is flashing red. Press the emergency stop if it is yellow to confirm operation and then release it to clear.
7. Bring the machine back to the machine Home by pressing the **Green Home Button** or
   a. Go to MDI page `(F2)`
   b. Press `MDI` button
   c. Enter `g28` and press `Run` button.
   Note: ensure the spindle will clear your clamping.
8. Check the collet is the right size for the bit and that both collet and spindle nut are clean. Careful not to cross thread the nut when putting it onto the spindle.
9. Put the bit into the collet so that there's 1-2mm of space between top of the flute and nut. This is important because it ensures the bit is more likely to clear obstacles and by having a better grip in the collet the bit is less likely to flex during milling (which could cause it to break).
10. Use two spanners and gently tighten.

Align Spindle to Stock

11. Manually move the spindle
    a. Select the Jog and Probing screen `(F3)`
    b. `Continuous Mode` button
    c. `1.0000` button initially and reduce as your bit is closer to the stock.
12. Using the Hand Pendant (or the screen buttons), manually move the machine so that it's close to the reference point on the stock, being careful to select the appropriate axis and speed.
13. Using a piece of paper (or a light behind the bit) very slowly/carefully lower the bit to set the **z** height. Then zero the **z** by pressing the `Z zero` button.
14. Move the bit up enough to clear the stock (a few millimetres is usually enough).
15. Repeat with the **x** and **y** and zero those.

If performing an Air Cut

16. Move **z** up by 20mm with instruction `g0z20` and then zero the **z** again so that the Work Origin and spindle is zeroed at 20mm above the stock.
    Note: this assumes your cuts won't be deeper than 20mm.

Load Program

17. Insert your thumb drive into the USB port.
18. Go to Load File `(F6)`.
19. On the screen showing the files to browse select the file to load (double-tap to open folders). Press the `Load` button. This will then load a picture of your model onto the screen.
20. Press the `Edit` button to check the code on the screen.
    Note: this assumes you have browsed your code post generation already and know what instructions to look for. The initial page will provide an indication of what the first cuts are and how deep they'll go. Check for z values that cut too deep.
21. If the code was generated in Fusion, check Tools and Offsets against your stock set up (z-offset in particular).[1]
22. Using the hand controller `(F3)` manually move the bit to the limits of the stock while watching the screen model to ensure the cut will stay within the boundaries of your stock.

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[1] Fusion 360 will generate tooling information at the top of your g-code. For example, in the below code example, the depth of z will reach -13mm.

```
(TOOLING)
(T1  D=4. CR=0. - ZMIN=-13. - FLAT END MILL)
```

23. Return to the Program screen **(F2)** and press the `Rewind` button **twice** to ensure you're at the start of the g-code programme.
24. Press the `Cycle Start` button and follow the instructions. You may need to press Start a few times.

Running the Program after an Air Cut

25. Once the Air Cut is complete, return the spindle to the work origin.
    a. Go to MDI page **(F2)**
    b. Press `MDI` button
    c. Enter `g0x0y0z0` and press `Run` button.
26. In the **z** field enter the value **20** and press the return button (↵) to ensure it has been accepted. This will now ensure that your Work Origin is aligned with your stock reference point again.
    Warning: it is very important to enter the correct value because an incorrect value can result in the z offset being wrong, leading to a risk of damage to the bit, spindle and/or machine bed.
27. Move the bit up so it's well clear of the stock.
28. Repeat steps 23 and 24 to start running your program.
29. When the program first starts, reduce the feed and speed to ensure the program is running ok. Increase the values as appropriate once cutting has started.

Cleaning Up

30. Once you've completed your cutting, use the Jog screen **(F3)** to move the spindle to a safe position for removal of the job, cutter bit and clamps.
31. Clean and vacuum the table and area and place all collets and clamps back in the rack.
32. Turn off the machine and remove the key and USB drive.
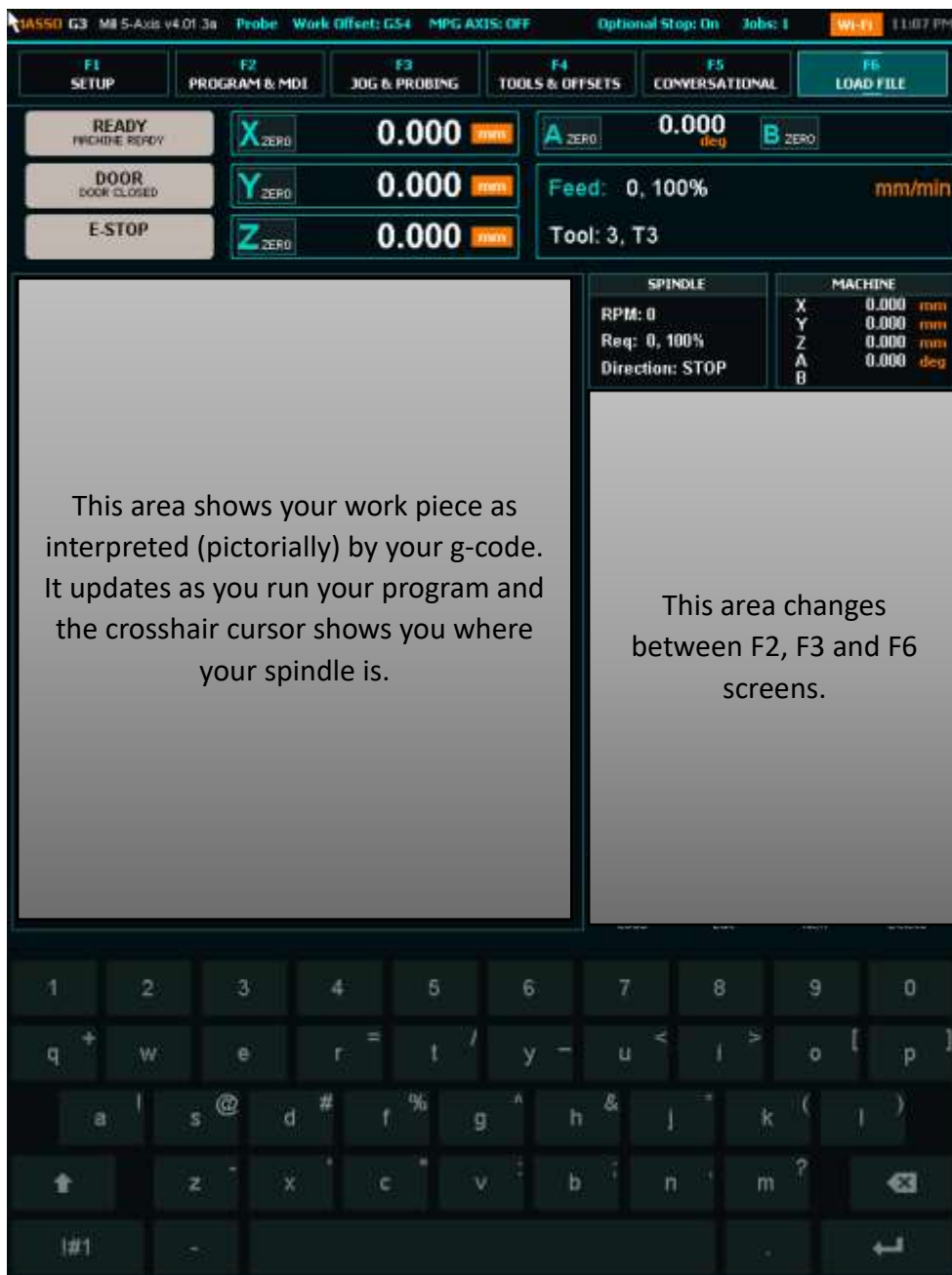33. Turn off power at the plug and return the key to the office or Supervisor.

Overview

The pictures below are of the different "F" screens, denoted as **(Fx)** in the instructions. These are accessible by pressing the relevant buttons at the top of the controller screen. In the example below, the **(F2)** screen is active.

MASSO **G3** Mill 5-Axis v4.01.3a	Probe	Work Offset: G54	MPG AXIS: OFF		Optional Stop: On	Jobs: 1	Wi-Fi	11:09 PM
F1 SETUP	**F2** PROGRAM & MDI	**F3** JOG & PROBING	**F4** TOOLS & OFFSETS	**F5** CONVERSATIONAL			**F6** LOAD FILE	
READY	**Y**		0.000 mm	**A**		0.000		**B**
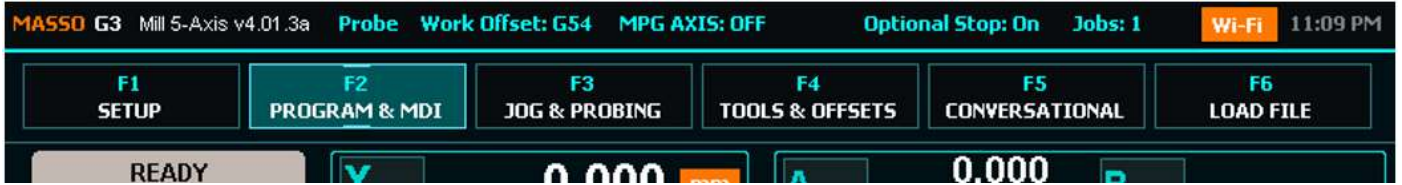
When we look at the F2, F3 and F6 screens (the main screens we will be using) there is only one area of the screen that changes so it helps to focus on that area once you're familiar with the rest of the screen.

This area shows your work piece as interpreted (pictorially) by your g-code. It updates as you run your program and the crosshair cursor shows you where your spindle is.

This area changes between F2, F3 and F6 screens.

F3 – Jog and Probing

Before loading/running a program, become familiar with the **(F3)** screen. This allows you to position your spindle at your Work Origin. It is also useful for comparing the limits of your work piece on the screen with the physical limits of your stock and clamps. The hand pendant (shown to the right) serves the same purpose as the buttons highlighted on the screen below.
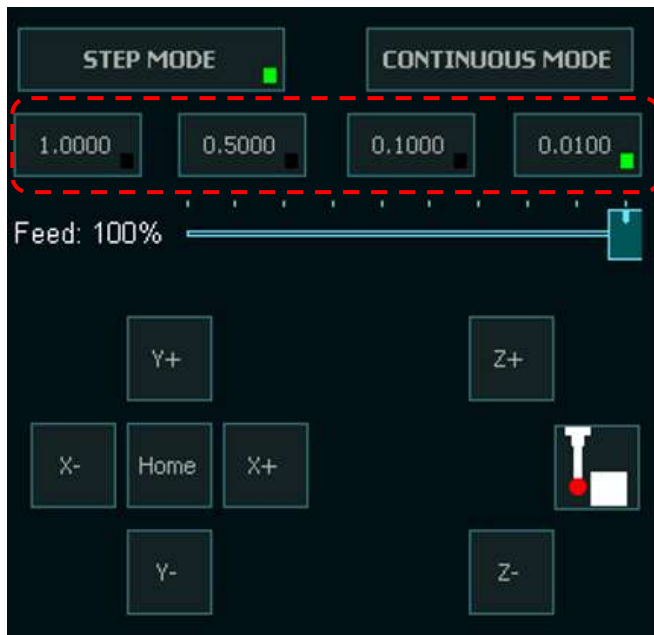
F6 – Load File

The F6 screen is used to load your program (g-code). Use the buttons and be careful not to accidentally press the "Delete" button – there is no confirmation before your code is deleted!

Once your code is loaded it will appear in the area above the buttons.
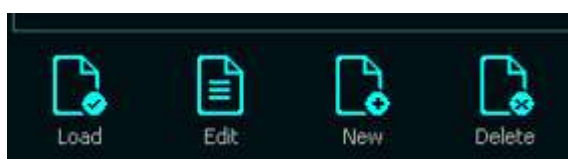
F2 – Program & MDI

This is the main screen when running your program. When the buttons highlighted in blue below are used, they are denoted as `this colour` in the instructions. For example, see the `MDI` button highlighted below.

Below is an example of a loaded work piece shown by the yellow lines. In the middle is the crosshair which represents the location of the spindle. It is important to ensure that this lines up with your Work Origin when setting up your stock.