

## Here's the latest update of the FLSun firmware:

Calibration is more precise and the A parameter has been removed from G33; anti-crash-code included in G33, so a manual calibration of DELTA\_HEIGHT is no longer required; configuration.h has been cleaned further; The LCD display has been debugged and no longer displays rubbish with negative values; Pins.h has been changed to enable '**autofan**' in configuration\_adv.h (a fan connected to the 'FAN' output of the board switches on/off when the nozzle reaches 45°); Marlin\_main.ccp has been cleaned in dept but no longer works on Cartesian printers.

## New and changed commands:

G29 seems to be in full working order now and is accessible from the LCD menu as well (there is not sufficient EEPROM memory to store the bed leveling data)

**G29 P(number of grid Points, min 3 max 15) B(bed probable radius)**

**G30** is working as well (probe at current XY location)

**M320** enable auto-level and **M321** disable auto-level are in the LCD menu tree (**M322** reset auto-level is not)

G33 points: P1-5 probes centre and towers – P6-10 centre, towers and opposite towers – P11-15 centre, towers, opposites and intermediate. If you want speed up things first calibrate with lesser points. G33 is also added to the LCD menus. The 'A' parameter is no longer required.

**G33 P(number of grid Points, min 1max 15) B(bed probable radius)**

**M206** has been disabled completely, it was pretty useless for deltas

**M212** has been changed from probing offset to printing offset so it takes effect immediately (no longer G29 or G33 required). You can set it from the LCD menu as well.

z-Height has been relocated to M665

**M665 H(z-Height) R(delta Radius) D(Diagonal rod) S(Segments per seconds)**  
**M666 X Y Z(end-stops)**

## Next release:

Still working on getting the tower corrections to work ... and maybe more ☺

## About auto-calibration and bed mapping

Some confusion exists to differentiate between those. On Cartesian printers bed-calibration consists only of adjusting the bed to be horizontally to the X and Y carriages. With G29 this can be done in two ways: 3 point calibration and detailed bed probing. Both do calculate the plane of the bed (defined by 3 points or least square method on a grid of points) and adjust in software for any differences. This is auto-bed-calibration.

Furthermore detailed probing also has the functionality of eliminating little bumps and dips in the bed by interpolating between the probe-grid and making small adjustments to the z-height. This is called detailed bed mapping. Both are done at the same time with G29 on Cartesian printers.

However on a delta-printer these are 2 completely different things. The bed is fixed to the frame on a delta so it can not be set parallel to X and Y carriages that do not even exist on a delta. Therefore on a delta only the detailed bed probing and bed mapping functions are maintained in G29. G29 does not do any calibration on deltas. Calibrating a delta printer is done by setting the delta-height so the nozzle is at print height when at coordinates  $z=0$ ; adjusting the end-stops so the triangle of the three carriages when homed is parallel to the bed; and adjusting the delta radius in order to eliminate that the bed is seen as domed or bowl-shaped. Further calibration can be done by adding tower adjustments to compensate for the triangle of the carriages not being perfectly equidistant.

Calibrating a delta printer is more difficult because: there are more things to adjust; all parameters are interconnected, you change one thing and this influences all the others; and the relationships are not linear as with Cartesian printers. Therefore an iteration process is required by checking the calibration points, adjusting the parameters, rechecking the probe-points, readjusting the parameters,... This is time consuming and these iterations can be automated. This process has been put in a new command G33.

Beware to turn off the auto-bed-level G29 when probing in order to manually calibrate a printer; with bed-mapping on you do not have a clue what the true probe heights are, so you can't calibrate correctly. And of course if you calibrate with bed-mapping turned on, once you turn off the printer the bed-map data is lost and the calibration is off. G33 in the Marlin-AC firmware does all this automatically.

## Calibration procedure

First load the Marlin-AC firmware in Arduino. There are a couple of things you may need to adjust in configuration.h (all changes to the original FLSUN firmware are commented with 'FLSUN' for easy lookup.

Here you can pick a name for your printer that shows on the LCD at startup.

```
#define CUSTOM_MENDEL_NAME "LVD's DELTA" // FLSUN choose your own
```

Define the radius where the printer is free from all the belts, most likely the fan will be the most restricting, so measure how much you can move the effector to the tower until the fan hits the belt and set it here:

```
#define DELTA_PRINTABLE_RADIUS 87.5 //75 with FLSUN original fan
```

Measure the z-height of the printer; this is the distance between the nozzle when homed and the bed. If it is within 15mm correct the software will adjust it without crashing into the bed.

```
#define DELTA_HEIGHT 273 // mm // 280 FLSUN original
```

Set your temperature sensors to match your configuration:

```
#define TEMP_SENSOR_0 5 // 5 FLSUN original  
#define TEMP_SENSOR_BED 0 // 0 FLSUN original
```

Set your PID parameters as you fine-tuned them with M303

```
#define DEFAULT_Kp 24.85  
#define DEFAULT_Ki 1.66  
#define DEFAULT_Kd 93.25
```

Set your E-steps; with the original extruder retract 150mm of filament and measure how much is really retracted; set your E-steps to that number.

```
#define DEFAULT_AXIS_STEPS_PER_UNIT {XYZ_STEPS, XYZ_STEPS,  
XYZ_STEPS, 150} //Extruder amount - E_STEPS was 150 FLSUN original extruder
```

The firmware is set up so that the green FAN connector switches on and off at full power when the hot-end reached 45°. If you want to restore the FAN connector to be controlled by the printer software restore the two following lines:

In configuration\_adv.h

```
#define EXTRUDER_0_AUTO_FAN_PIN -1 // was -1 FLSUN original
```

and in pins.h

```
#define FAN_PIN 9 //9 FLSUN original disabled in order to set Auto Fan
```

Now you're set to compile and upload to board. As always when changing firmware do a M502 M500 sequence to reset the EEPROM;

To calibrate the printer run G33

You can set the number of points and the probe radius with

**G29 P(number of grid Points, min 3 max 15) B(bed probable radius)**

Or use the defaults set in configuration.h

```
#define DELTA_GRID_POINTS 6
//min 1 max 15; P=1-5 probes 4 points (centre + towers) / P=6-10 probes 7 points
(centre + towers + opposite towers)/ P=11-15 probes 13 points (centre + towers +
opposite towers + intermediate)

#define DELTA_PROBABLE_RADIUS (DELTA_PRINTABLE_RADIUS - 2.5)
// Here the probe is set to leveling the range of movement, Increasing the leveling
range, reduce the "-50" This value, Reducing leveling range, increase the "-50" value
```

You can change these defaults to your liking.

The command no longer requires the A parameter. It probes the bed once, if calibration is still within limits it stops, if not it starts the calibration process of iterations. When the process is finished it does a final check if the calibration is stable, if not it continues the iterations until it does.

After calibration is finished save the settings with M500

At this time you can use the values of the end-stop adjustments to physically adjust the screws on the carriages in order to minimize the software adjustments (manually calibrating) and repeat the G33 command to check the changes you made.

The last thing to do is to determine the z-offset. Every printer is different and this depends on how you tuned the probe with screw on the effector. Do a couple of test prints and set the z-height with one of these methods:

- add a z-offset in your slicer settings (you need to re-slice every time you change this)
- set the z-offset with M212 Zx.xx and save with M500
- set it on the fly while printing (*not tested yet*) on the LCD menu>control>motion>z offset and save it on the LCD menu>control>store memory

Now your printer is calibrated.

You may want to carve these settings in stone as the default factory settings by adjusting configuration.h

```
#define DELTA_RADIUS 104.95 // mm
#define DELTA_HEIGHT 270.74 // mm // 280 FLSUN original
#define Z_OFFSET 0.125 // mm
```

If you want to change these settings manually without recompiling you can use these commands:

**M665 H(delta Height) R(delta Radius) D(Diagonal rod) S(Segments per seconds)**  
**M666 X Y Z(end-stops)**

Finally you can create a detailed bed map that is used while printing by interpolation between the bed points. The results can not be stored in EEPROM. Use these commands:

**G29 P(number of grid Points, min 3 max 15) B(bed probable radius)**

The default values are set to your liking in configuration.h:

```
#define AUTO_BED_LEVELING_GRID_POINTS 15
//Min 3 Max 15 - Automatic leveling probes, point 3 points, vertical and horizontal
//axes each point three points,the total is 9 points;If changed to 6, the vertical and
//horizontal axes points 6 points each, a total of 36 points.

#define AUTO_BED_LEVELING_PROBABLE_RADIUS
(DELTA_PRINTABLE_RADIUS - 7.5)
// Here the probe is set to leveling the range of movement,Increasing the leveling
//range, reduce the "-50" This value,Reducing leveling range, increase the "-50" value
```

**M320** enable auto-level and **M321** disable auto-level (are in the LCD menu tree as well) and **M322** reset auto-level.