Here's the latest update of the FLSun firmware:

Tower corrections are now functional and a new M667 command has been added for advanced calibration with the procedure described in
http://www.thingiverse.com/thing:745523

New and changed commands:

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. G33 calibrates Z-height, end stops, delta radius and tower radius corrections (if P>5)

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

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.

M665 H(z-Height) R(delta Radius) XYZ (Radius corrections) D(Diagonal rod) S(Segments per seconds)

M666 X Y Z(end-stops)

M667 ABC(Tower Angle corrections) XYZ(Diagonal Rod corrections)

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 ata is lost and the calibration is off. G33 in the Marlin-AC firmware does all this automatically.

Calibration procedure

Setup

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 choose 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 100mm 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.

IMPORTANT: after uploading always when changing firmware do a M502 M500 sequence to reset the EEPROM;

Calibrating the stepper motors

To calibrate the extruder stepper heat up the hot end, mark the filament at fixed point and retract 100 mm; measure how much is retracted and change the steps per unit with M92 E149 and save with M500.

The number you need to input is: original steps per unit (150) / measured length * 100

Do the same thing with the XYZ steppers; mark a fixed point on the frame of all 3 axes lower the effector 100mm (G90 and G1 Z-100) and mark again. Measure how much each carriage has moved down and change the steps per unit with M92 X100 Y99 Z101 and save with M500

Again the numbers you need to input is: original steps per unit (100) / measured length * 100

Calibrating the endstops

Run a quick calibration with G33 P1 C0.03 and look at the end stop corrections that are obtained when the procedure finishes. Try adjusting the screws on the carriages so the end stop corrections are all close to zero. The simplest way is to take the tower that has the zero correction and adjusting that screw clockwise (fastening the crew). Turn it so another tower just takes the zero correction. One full turn is about 0.5mm. Rerun G33 P1 C0.03 until all end stop corrections are within 0.3mm.

Calibrating the Z-offset

Run a G33 P6 first to calibrate the printer; then print an object and see if the first layer sticks to the bed without the nozzle scraping over the surface.

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 on of these methods:

- set the z-offset with M212 Z0.25 and save with M500
- set it on the fly while printing on the LCD menu>control>motion>z offset and save it on the LCD menu>control>store memory

Diagonal rod calibration

Print an object and measure it in the horizontal plan in all direction. You can set the diagonal rod to set an overall scale correction (the average of the measurements of the print object) with M665 D217.4.

The number required for the new delta rod is: measured size/object size (60) * diagonal rod (218)

Advanced calibration

See the procedure in http://www.thingiverse.com/thing:745523

You can set individual scale corrections: set the differences to the average of the three XYZ measurements of the print object with M667 X-0.01 Y-0.01 Z0.02.

The number required for these are: measured difference/object size (60) * diagonal rod (218)

You can also change the tower angles to the measured one with M667 A119 B120.5 C120.5; (A= angle between X and Y, B= angle between Y and Z and C= angle between Z and X). To save all these settings use M500.

Note that M667 Axx Byy Czz (tower angle corrections) and M667 Xxx Yyy Zzz (diagonal rod corrections) are incremental and will add the changes to the ones already set previously (just like M665 Xxx Yyy Zzz for delta radius corrections). To reset to zero enter 3 zero values.

Calibration precision

Run a G33 P6 C0 command. This will put the routine into an endless loop; the program will abandon after 30 iterations. You can set de default precision in configuration.h to the maximum precision that was achieved or slightly above.

#define CALIBRATION_PRECISION 0.03 //mm

As well you change the default number of points and bed radius for calibration.

#define DELTA_GRID_POINTS 8
#define DELTA_PROBABLE_RADIUS (DELTA_PRINTABLE_RADIUS - 2.5)

Now you just need to run just a G33 command every time your printer needs recalibrating

Setting factory defaults

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

The steps per unit for the extruder and XYZ motors can be set by changing:

*#define DEFAULT_AXIS_STEPS_PER_UNIT {XYZ_STEPS*100/100, XYZ_STEPS*99/100, XYZ_STEPS*101/100, E_STEPS*99/100}*

The endstop corrections can be set with (all number must be negative or zero)

#define DELTA_ENDSTOP_ADJ_X 0
#define DELTA_ENDSTOP_ADJ_Y -0.07
#define DELTA_ENDSTOP_ADJ_Z -0.14

The delta radius and radius corrections with (sum of the corrections must be zero):

#define DELTA_RADIUS 104.7

#define DELTA_RADIUS_ADJ_X 0.4
#define DELTA_RADIUS_ADJ_Y 0.2
#define DELTA_RADIUS_ADJ_Z -0.6

The delta Z_height and the Z_offset:

#define DELTA_HEIGHT 270.7
#define Z_OFFSET 0.25

The advanced parameters can be hardcoded with (sum of the diagonal rod corrections must be zero / sum of the angle corrections must be zero or 360):

#define DELTA_DIAGONAL_ROD 217.4 // 218 FLSUN original

#define DELTA_DIAGONAL_ROD_ADJ_X -0.1
#define DELTA_DIAGONAL_ROD_ADJ_Y -0.1
#define DELTA_DIAGONAL_ROD_ADJ_Z 0.2

#define DELTA_ANGLE_ADJ_XY 119.0
#define DELTA_ANGLE_ADJ_YZ 120.5
#define DELTA_ANGLE_ADJ_ZX 120.5

Bed levelling

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

#define AUTO_BED_LEVELING_PROBABLE_RADIUS (DELTA_PRINTABLE_RADIUS - 7.5)

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