



## WIZARDS

# Delta printer least-squares calibration calculator

## Instructions

This calculator implements the least-squares delta calibration algorithm that RepRapFirmware has built-in. I have provided it as a service for those not running RepRapFirmware. You can choose to calibrate the following parameters:

- 3 factors (endstop corrections only)
- 4 factors (endstop corrections and delta radius)
- 6 factors (endstop corrections, delta radius, and two tower angular position corrections)
- 7 factors (endstop corrections, delta radius, two tower angular position corrections, and diagonal rod length)

It deliberately doesn't adjust any other tower position coordinates, because doing so isn't helpful. Any adjustment to the 6 possible tower position coordinates is equivalent to adjusting the delta radius and two tower angular positions, plus a translation of the bed origin and a rotation of the bed. You don't want to rotate the bed - that will just move the height errors to points you haven't probed. You don't want to translate the bed either - as well as moving height errors to points you haven't probed, it will reduce your print area because the bed origin will no longer be equidistant from the towers.

I recommend using 6 factors. Unless you measure nozzle heights a very long way out opposite each of the towers, there is insufficient information to determine diagonal rod length accurately.

To use the calculator:

1. If you have any tower radius corrections configured in your firmware, remove them.
2. Enter your current diagonal rod length, delta radius, homed height, endstop corrections, and tower position corrections. The tower position corrections are in degrees anticlockwise viewed looking down on the printer. All other values are in mm, except that if the firmware type is set to Repetier then the initial endstop corrections are in steps.
3. Choose how many factors to calibrate (see below).
4. Choose some points covering all areas of the bed at which to measure the nozzle height error. The calculator will suggest some if you enter your printable radius, select 4, 7 or 10 points, and press the **Suggest probe points** button. Alternatively, choose your own. The XY coordinates of each point must be the coordinates of the nozzle, not the coordinates of the Z probe if you are using one.
5. Measure the nozzle height errors at those probe points, then enter the values in this calculator along with your machine parameters. Enter positive height errors where the nozzle is too high, and negative height errors where it is too low.
6. Press the **Calculate**. Check that the calculator reports success.
7. Copy the output parameters to your machine. You can use the generated M665 and M666 commands to do some or all of this for you, depending on your firmware.
8. Repeat the whole process once more. Two iterations should be sufficient unless your calibration was a long way off initially.

You can send feedback to me using the [Contact form](#).

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## Update history

2016-01-01	Corrected sign of nozzle height errors Added MarlinRC option Invert endstop corrections where necessary Corrected homed carriage height calculation Generate suggested points for 4-point probing Generate M665 D E H Z parameters when Smoothieware is selected
2016-01-17	Corrected sign of endstop corrections when Repetier is selected Normalise endstop corrections to be all positive when Repetier is selected Trap errors if probe points are unreachable or not distinct
2016-01-31	Added R parameter to generated M666 command when Marlin RC firmware is selected Added "Copy to initial parameters" button
2016-03-30	Added D parameter to generated M666 command when Marlin RC firmware is selected Corrected call to function SwapRows from GaussJordan

Firmware type:  RepRapFirmware  Smoothieware  Repetier  Marlin (standard)  Marlin (Rich Cattel)

Steps/mm (for Repetier only):

Initial endstop corrections: X:  Y:  Z:

Initial diagonal rod length:

Initial delta radius:

Initial homed height:

Initial tower angular position corrections: X:  Y:  Z:

Printable bed radius:

Number of probe points:

Number of factors to calibrate:

Normalise endstop corrections?

Point 0 X:  Y:  Nozzle height error:

Point 1	X:	<input type="text" value="164.8"/>	Y:	<input type="text" value="95.15"/>	Nozzle height error:	<input type="text" value="0.5"/>
Point 2	X:	<input type="text" value="164.8"/>	Y:	<input type="text" value="-95.15"/>	Nozzle height error:	<input type="text" value="0.03"/>
Point 3	X:	<input type="text" value="0"/>	Y:	<input type="text" value="-190.3"/>	Nozzle height error:	<input type="text" value="-0.05"/>
Point 4	X:	<input type="text" value="-164.8"/>	Y:	<input type="text" value="-95.15"/>	Nozzle height error:	<input type="text" value="0.1"/>
Point 5	X:	<input type="text" value="-164.8"/>	Y:	<input type="text" value="95.15"/>	Nozzle height error:	<input type="text" value="0.02"/>
Point 6	X:	<input type="text" value="0"/>	Y:	<input type="text" value="95.15"/>	Nozzle height error:	<input type="text" value="0.15"/>
Point 7	X:	<input type="text" value="82.4"/>	Y:	<input type="text" value="-47.57"/>	Nozzle height error:	<input type="text" value="0.15"/>
Point 8	X:	<input type="text" value="-82.4"/>	Y:	<input type="text" value="-47.58"/>	Nozzle height error:	<input type="text" value="0.02"/>
Point 9	X:	<input type="text" value="0"/>	Y:	<input type="text" value="0"/>	Nozzle height error:	<input type="text" value="0.02"/>

**Success! Calibrated 6 factors using 10 points, deviation before 0.19 after 0.03**

New endstop corrections:	X:	<input type="text" value="0"/>	Y:	<input type="text" value="-0.99"/>	Z:	<input type="text" value="-1"/>
New diagonal rod length:		<input type="text" value="468.5"/>				
New delta radius:		<input type="text" value="235.8"/>				
New homed height:		<input type="text" value="840.87"/>				
New tower position angle corrections:	X:	<input type="text" value="-0.24"/>	Y:	<input type="text" value="-0.39"/>	Z:	<input type="text" value="0"/>

Commands:

```
M665 R235.80 L468.50
M666 X0.00 Y-0.99 Z-1.00
; Set homed height 840.87mm in config.h
```

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