TDCM

HIGH PERFORMANCE PROPULSION

BBTS Installation Guide

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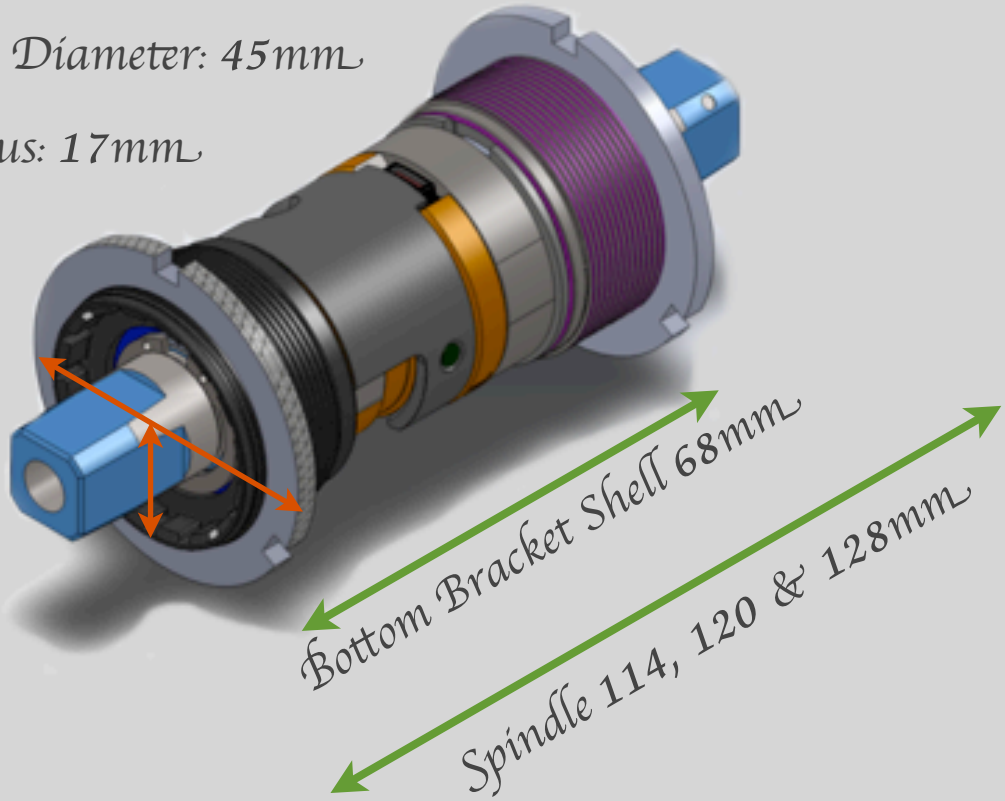
Performance 1	Torque [Nm]
Performance 2	Speed [rpm]
Performance 3	Rotational Direction
Performance 4	Left / Right pedal
Signal 1	Torque [Nm]
Signal 2	Sine [12 pulse]
Signal 3	CoSine [12 pulse]
Signal 4	Left / Right pedal

Adjusting Cap Diameter: 45mm

Internal Radius: 17mm



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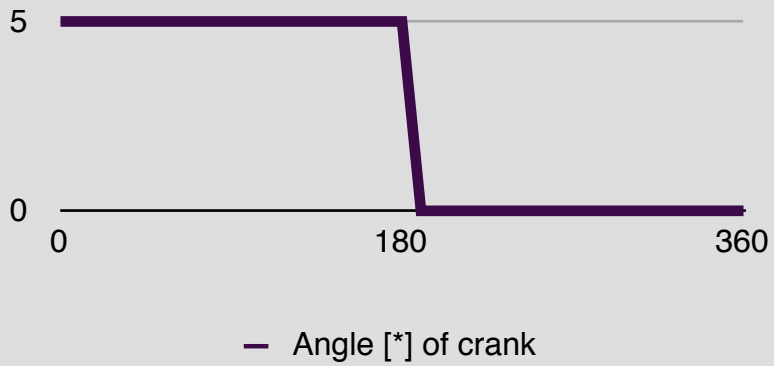
Programming

Using a combination of the torque, speed, rotational direction and left & right pedal signals, using TDCM's bottom bracket torque sensor can be implemented into an ebike drive system to provide the ultimate riding feeling.

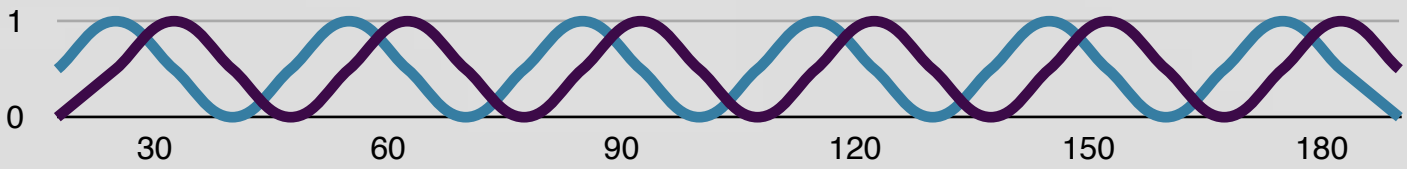
Left & Right Signal

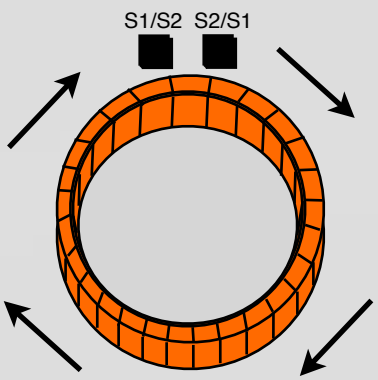
The left and right signal is the most simple, allowing the controller to determine which pedal is in the forward postion. In conjunction with Sin and CoSine signals it can provide extra safety and accuracy in the driving feeling.



Sine and CoSine

As the bottom bracket rotates, with the pedal movement, sensors S1 and S2 provide 24 impulse signals. These signals can be used to calculate pedal direction, act as a duel speed/torque sensor and act as a critical part of ensuring the drive system is safe.





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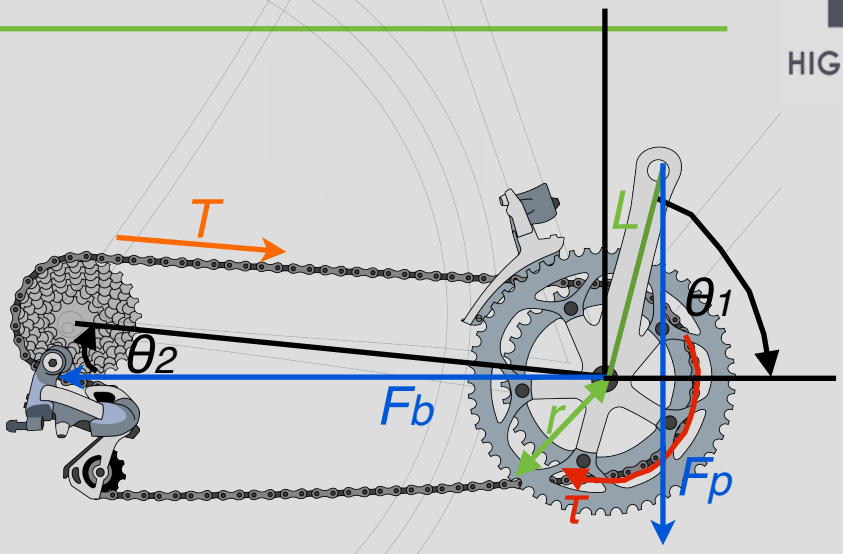
$\tau = Fp \times \cos\theta 1 \times L$

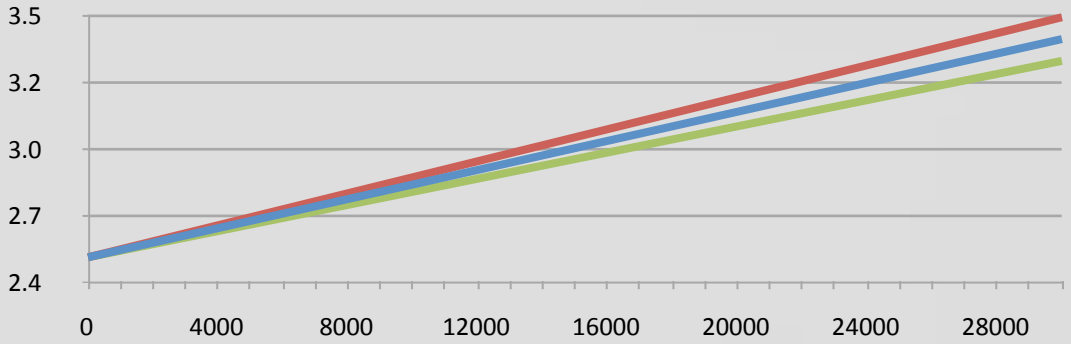
$T = \tau / r$

$Fb = T \times \cos\theta 2$

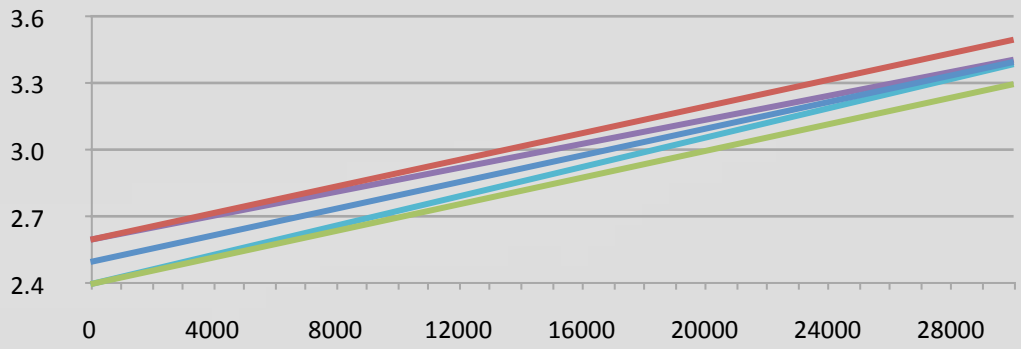


Torque

The torque signal responds directly to pedal force applied, as can be seen in the diagram above. It is important to note that the signal can vary dependant on the material variance from suppliers. For example the graph below shows how 3 different sensors can have a starting signal of 2.5V however ending on slightly different voltages.



Similarly, the second graph below shows how the blue, red and green sensors all have exactly the same performance but slightly different starting (and as a result ending) voltages. Where the purple and aqua sensors have a slight material sensitivity compared to the blue sensor, however the same ending voltage. In this second case the purple line will be made of a slightly harder material and the aqua sensor slight softer.



When programming the drive system, it is important to understand these variations occur and program accordingly, having a controller that can read the starting voltage and then calibrate the whole system each time the bike is turned on.

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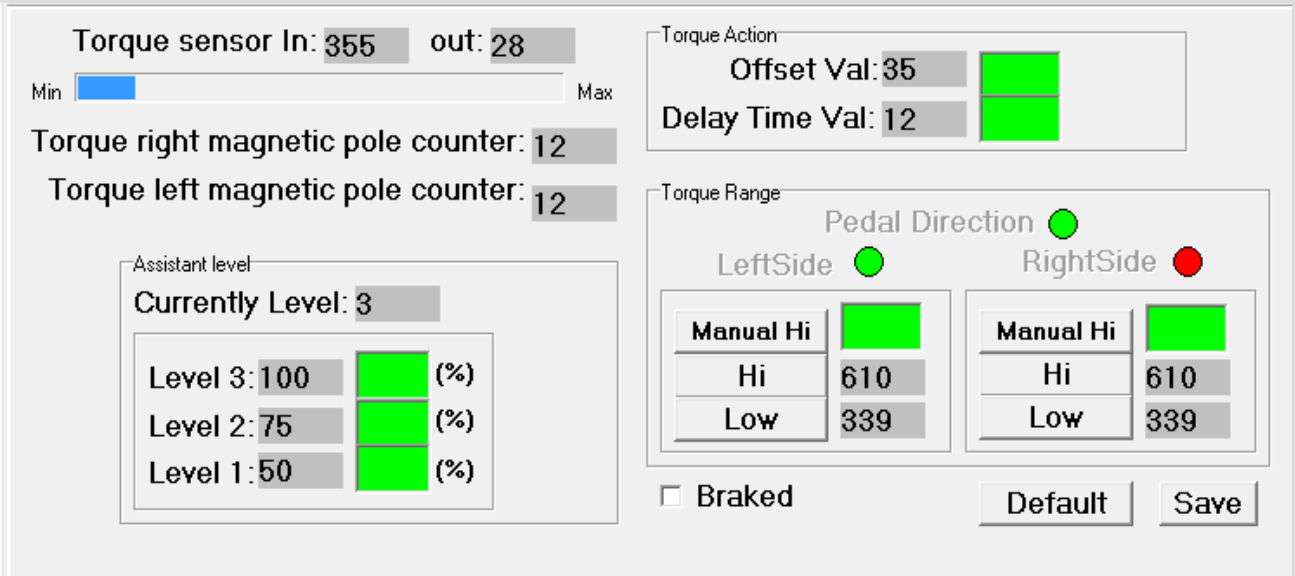
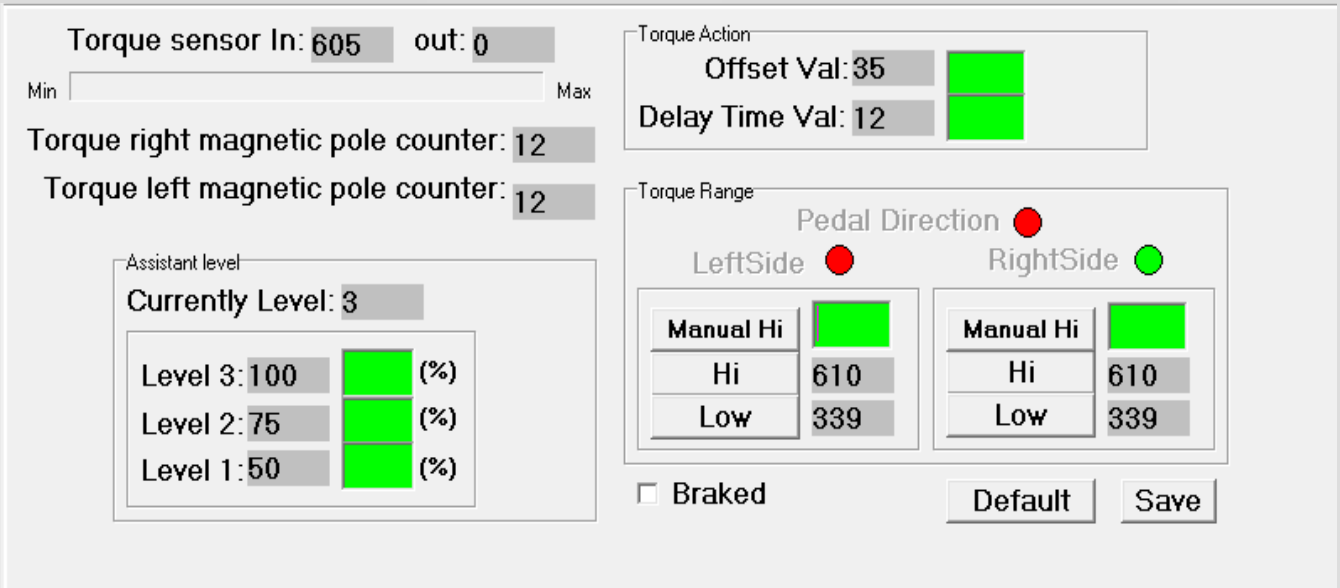
For example TDCM's drive system uses its own software package to equate for this variation to ensure all bike have the same riding feeling.



This top screenshot shows how the normal operation of the torque sensor works.
The 24 pulses are correctly recorded as the pedals rotate, 12 from the right side and 12 from the left.
A small amount of torque is being recorded in the blue bar, giving a signal of 355.
Pedal direction is green, indicating the pedals are moving in the correct forward motion.
Currently the force is being applied to the left side pedal.

The below screenshot shows the torque signal at a stationary position (brake applied, pedal in horizontal position). As a result there is no blue bar to indicate the torque signal being sent out and the pedal direction key is red.
From here the manual high can be input by applying a force of over 35kg to the stationary pedal and recording the sensor signal, in this case 605 rather than the automatic high of 610.
This simple adjust will mean the riding feeling of all bike models will have the same sensation.



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Safety precautions should be considered when programming the torque sensor.
TDCM recommends implementing the following safety programming into all drive systems.
Please also see pages 18 - 19 for signal checks and further notes on operation.

Sensitivity to chain tension:

The torque sensor measures the movement of the axel. As a result by putting tension on the chain or by pulling the chain a torque signal may be produced thus providing a signal to controller and motor.

To equate for this, it is advised that the controller doesn't pick up the lower ranges of torque signal output by using a signal offset, thus not picking up on small applications of force such as accidental tention on the chain.

Torque produced by backwards peddling:

The torque sensor measures movement of the axel. As a result peddling backwards will produce a torque signal.

To prevent this signals 4 and 6 from the pin define measuring the 24 impulses should be studied. Once the order of occurrence is known the controller should be programmed to only work in one direction. For example quarter phase S1 first and then quarter phase S2 second and to not give an output to the motor if the opposite is true. S2 is first and S1 is second.

Ghost riding:

Pressure on the pedals will still produce a torque signal, even if the rider is stationary at traffic lights or resting.

To avoid, the controller should only recognise the torque signal when the pedals are rotating forward The torque signal should be ignored by using signals 4 and 6 so that the controller knows the rotational postion of the pedals and whether the pedals are rotating or not.

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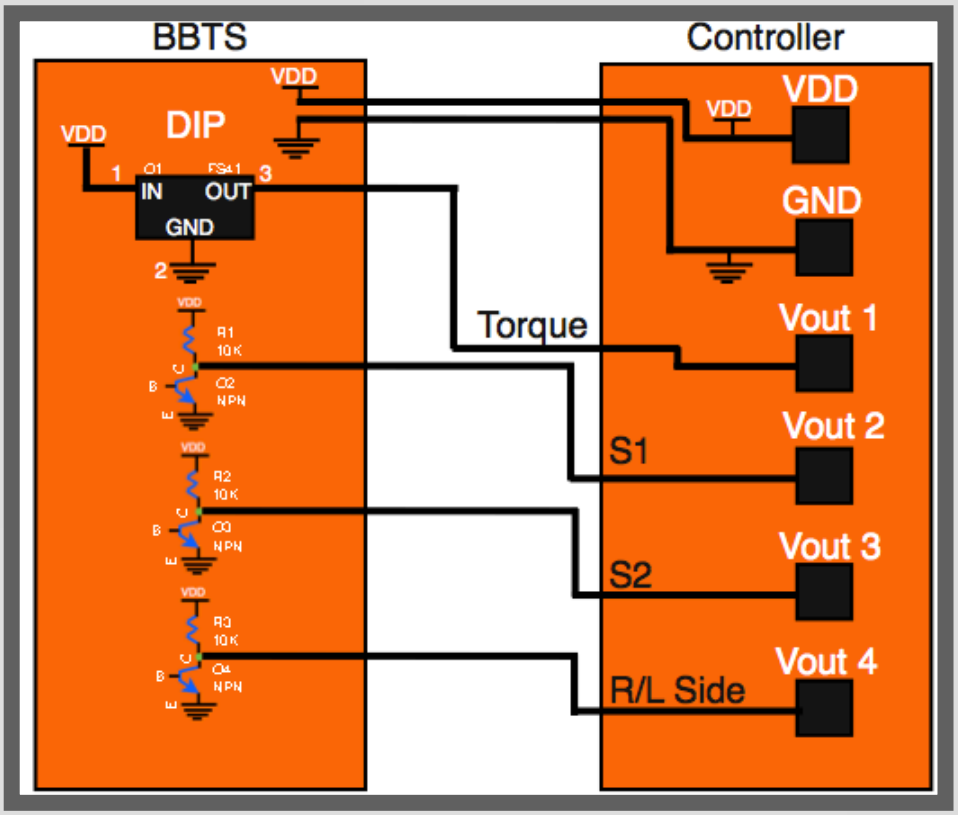
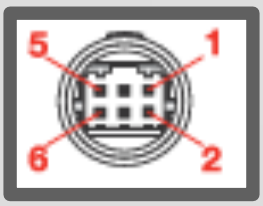
BBTS to Controller Interface



Output Resolution 23 m V/Nm



Lead	Description	Signal
White	Output	Left-Right Foot
Red	Power Supply	+5/6 VDC
Black	Ground	OV
Yellow	Output	CoSine
Green	Output	Torque
Blue	Output	Sine

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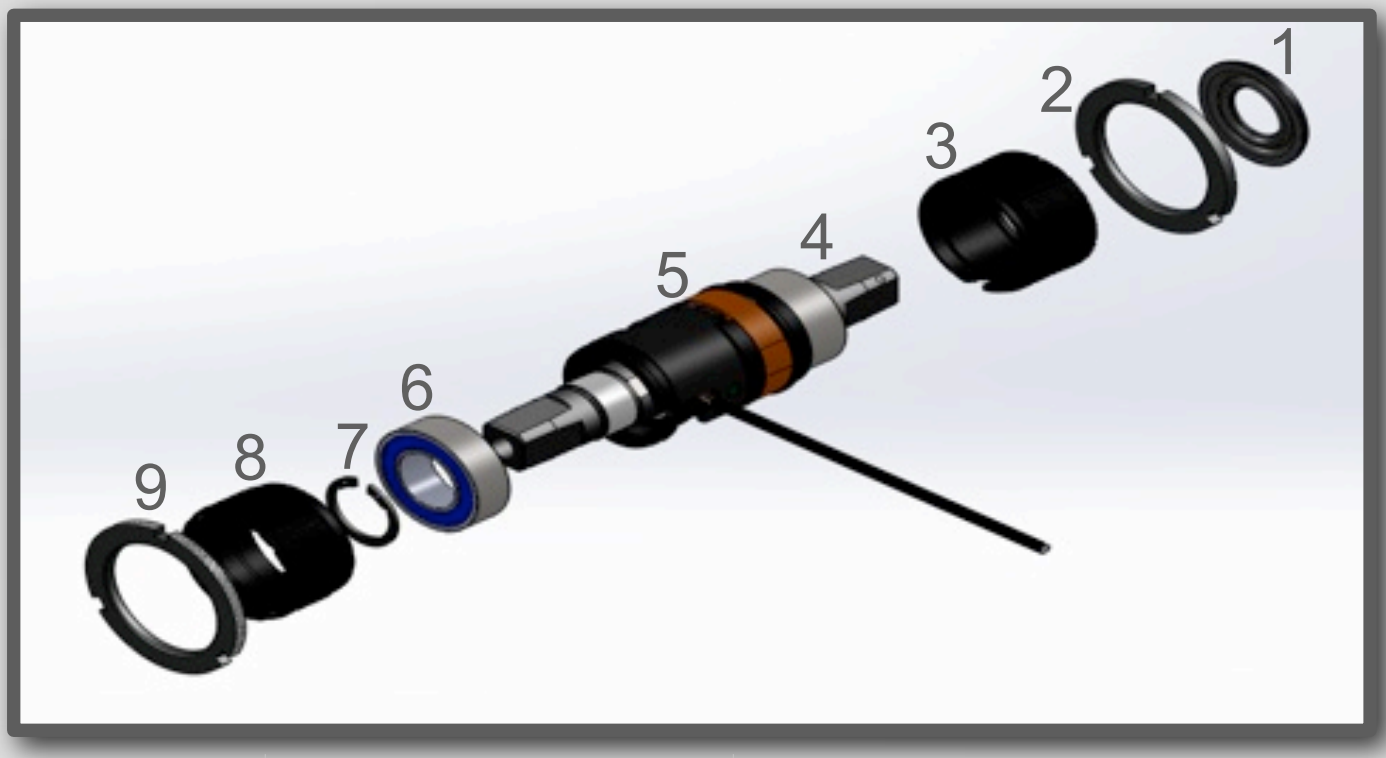
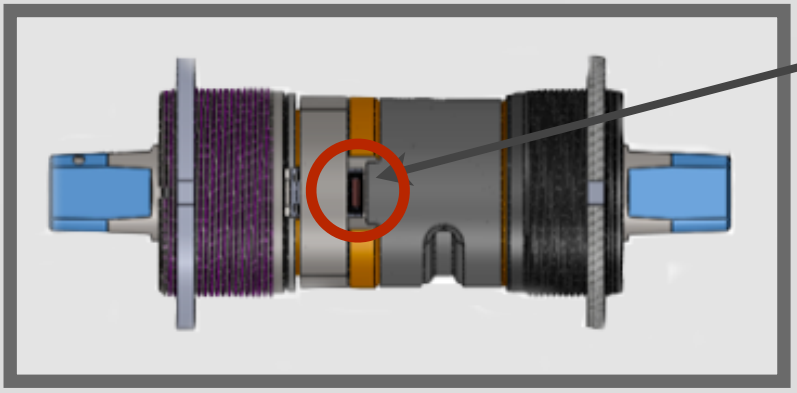
Explore Drawing



1	Rubber Dust Seal	Disassemble for installation
2	Right Side Lock Ring	Disassemble for installation
3	Right Side Adjusting Cap	Disassemble for installation
4	Spindle	Do not disassemble
5	Torque Sensor Shell	Do not disassemble
6	Roller Bearing / Ball Bearing	Disassemble for installation
7	Snap Ring	Disassemble for installation
8	Left Side Adjusting Cup	Disassemble for installation
9	Left Side Lock Ring	Disassemble for installation



Please avoid pressing down on this area at all costs as it will affect the calibration of the torque sensor.

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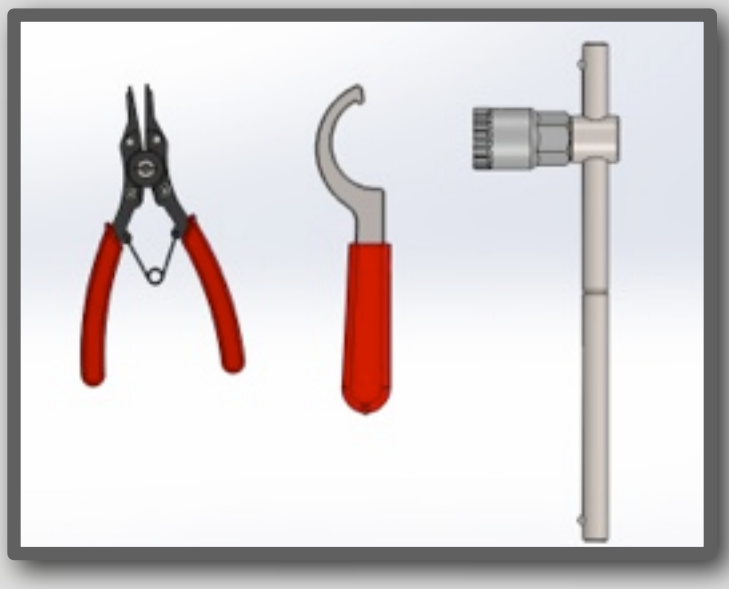
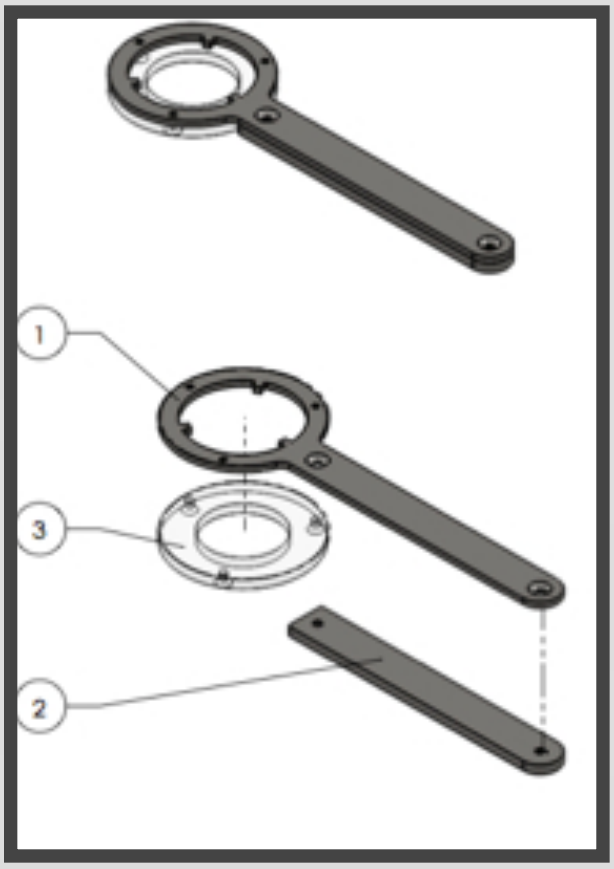
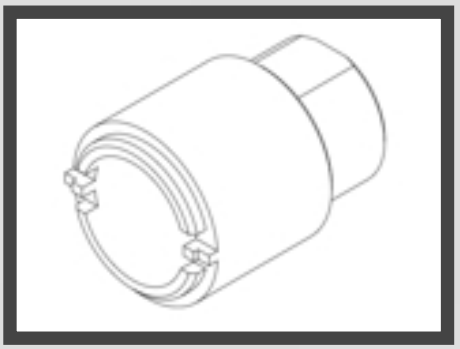
Recommended Tools

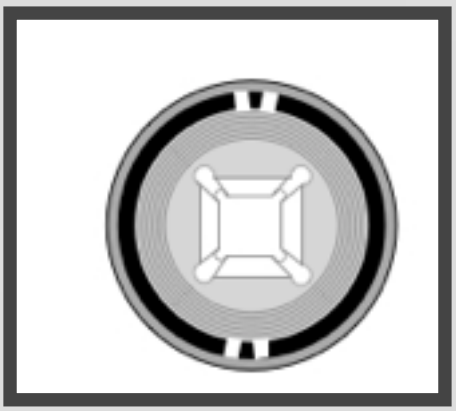


1. External snap ring pilers (Snap-On #PR15 or equivalent)
2. Hook spanner wrench
3. Standard bottom bracket socket wrench
4. Light, high quality grease (Park Tools PolyLube 1000 Lubricant or equivalent)
5. Power supply

TDCM Specialized Tools







TDCM will provide specific tools for mass production orders if requested by customer to make installation easier, quicker and more efficient.
If these tools are also required for sample orders please contact TDCM on this matter.

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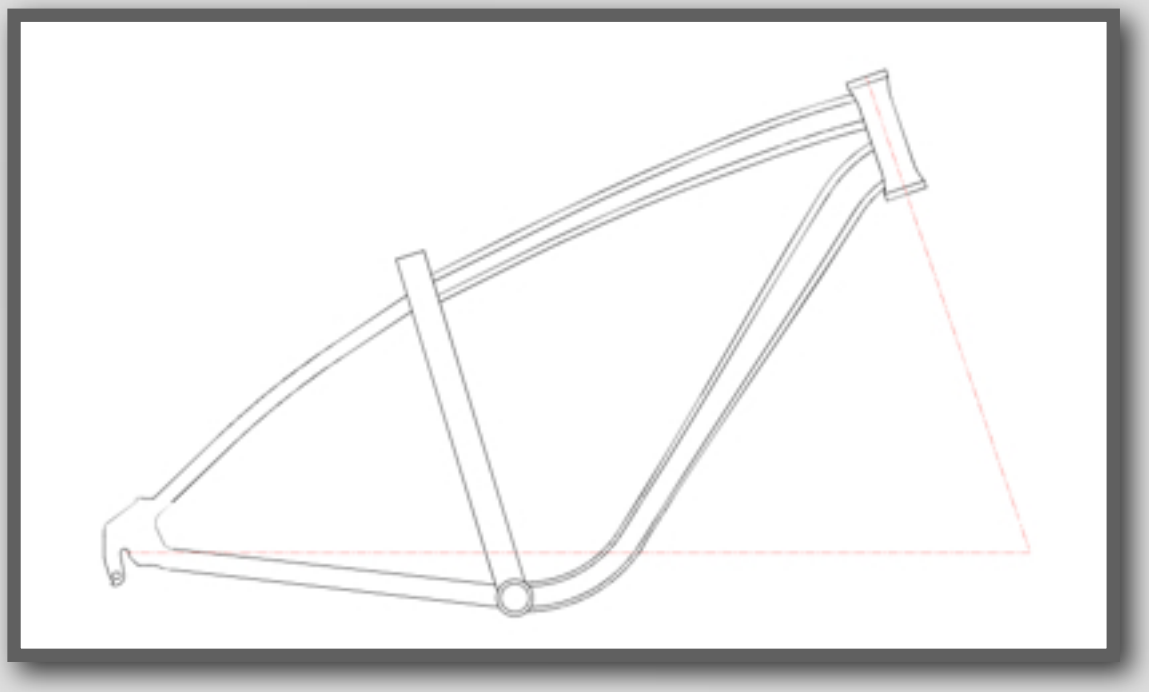
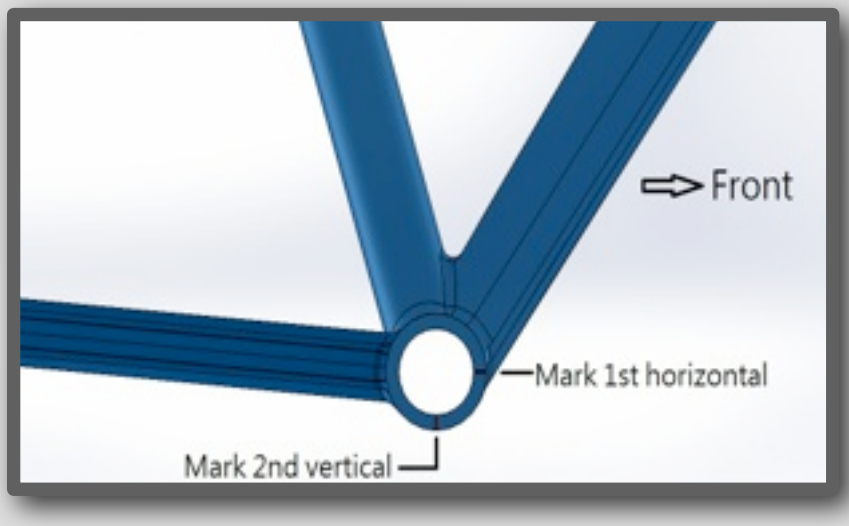
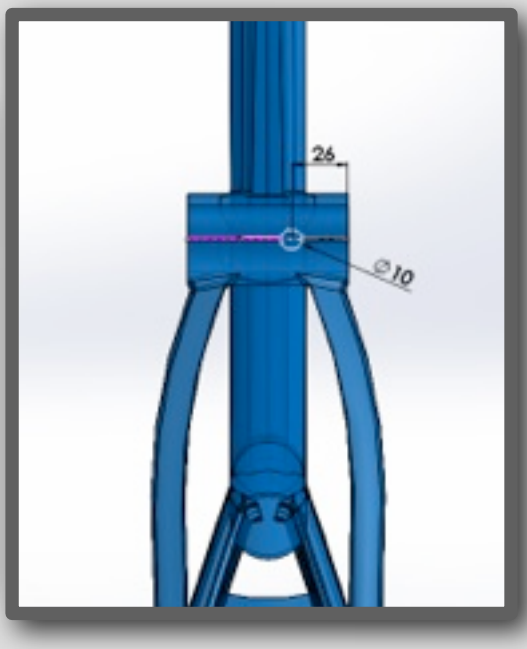
Bike Preparation



1. Create a reference point on horizontal and vertical planes, which correspond to the hub axels.
2. With the bike upside down create reference point 26mm from the left side and drill a 10mm diameter hole, for the connector wire.
3. Horizontal reference point should only have +/- 2° tolerance.
4. Total assembly tolerance should only be +/- 5° tolerance.





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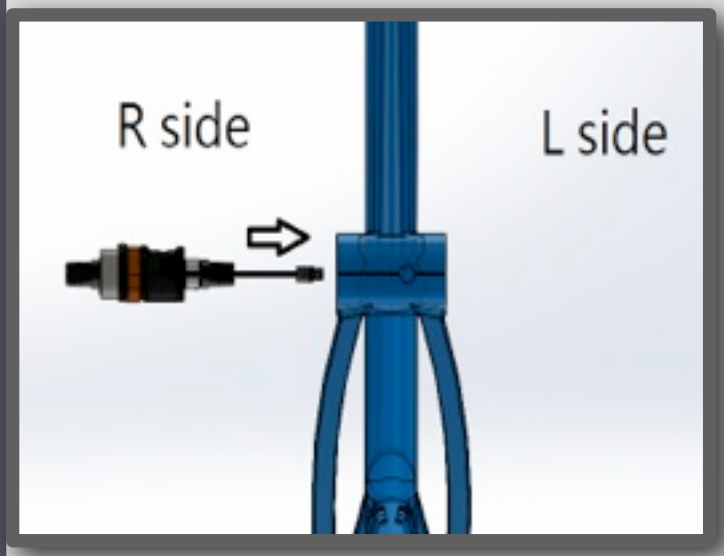
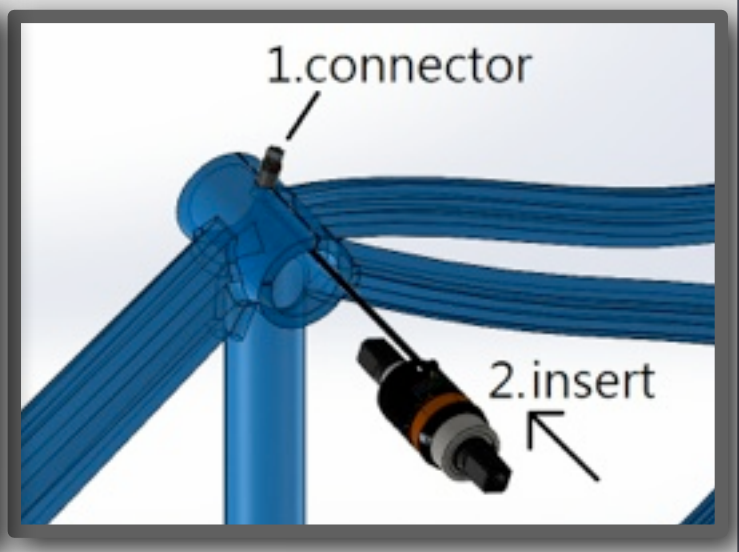
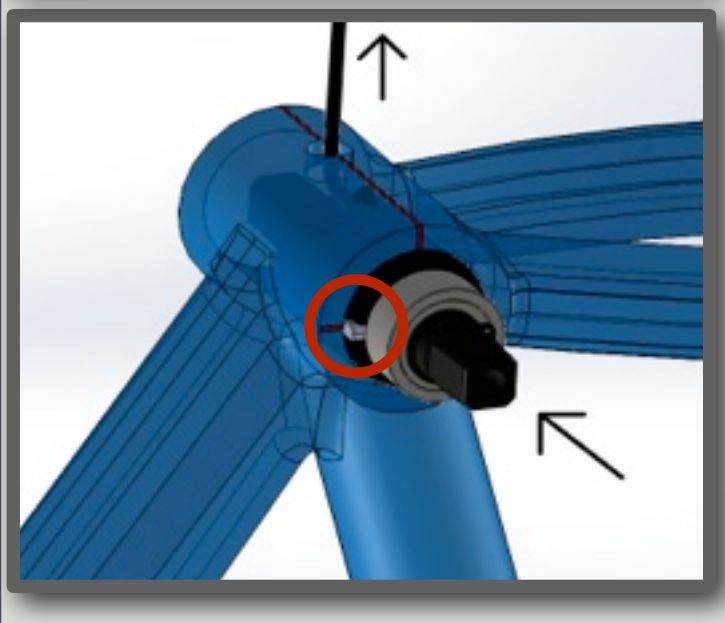
Installation of torque sensor into the bottom bracket







1. Simply insert the torque sensor into the bottom back as in the photos from bike right side to bike left side.

2. Carefully insert connector cable into the 10mm drilled hole and pull the cable through as the torque sensor is inserted to take up the slack.

3. Through out assembly keep the key as highlighted in red in the horizontal position for the best consistency in sensor reading.

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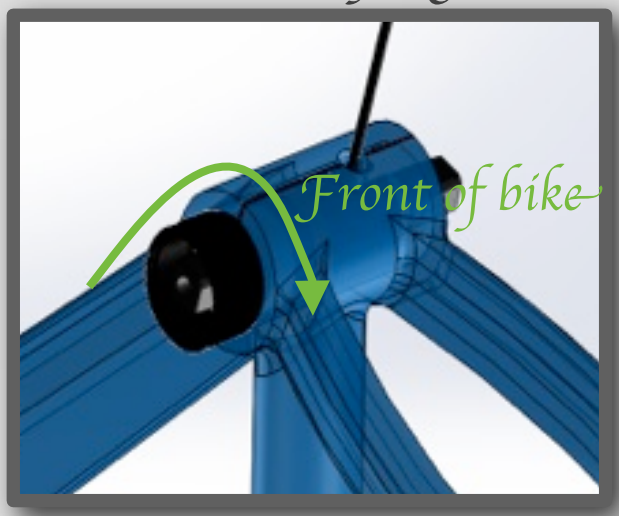
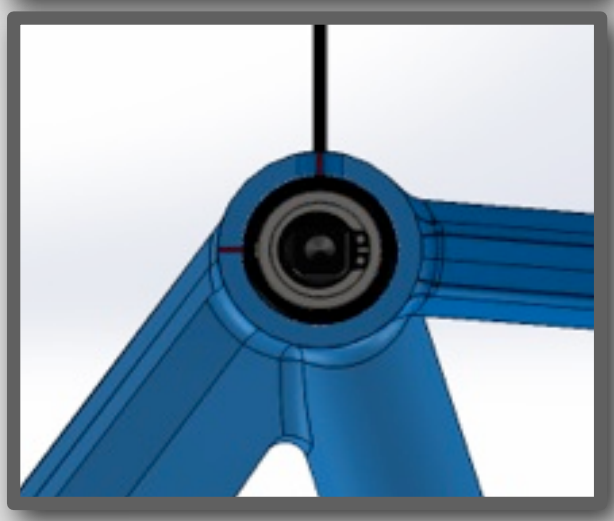
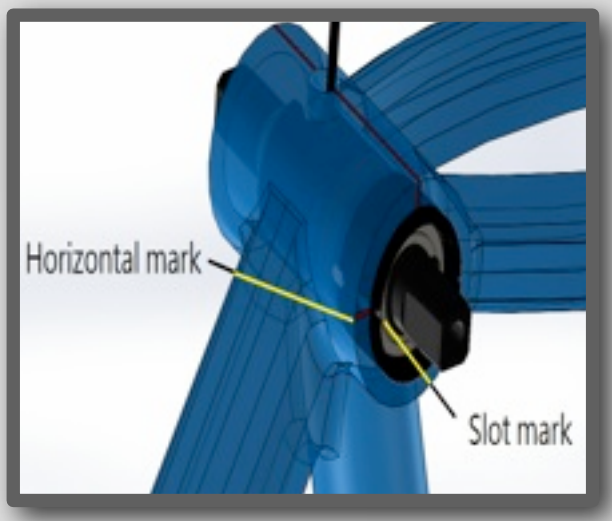
Installation of right side

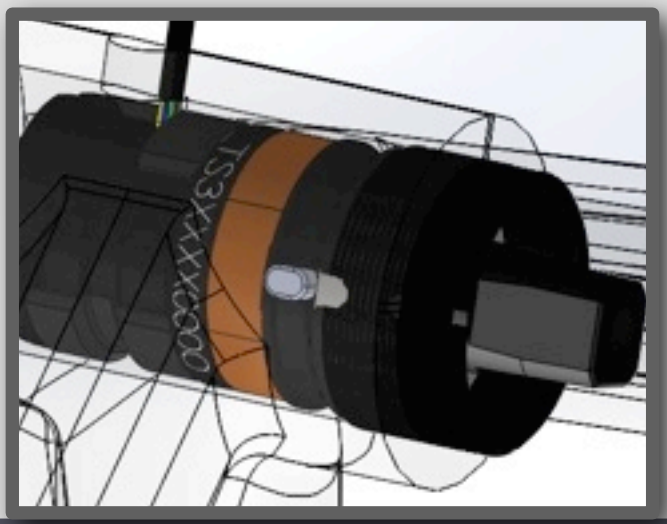


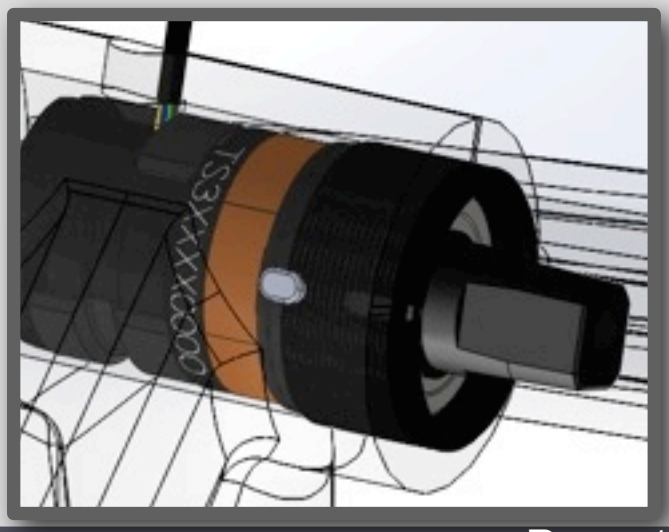
1. Use a light coating of grease on the treads of the Right Side Adjusting Cup.
2. Screw the Right Side Adjusting Cup into the bottom bracket shell.
3. Please note the Right Side Adjusting Cup has left-hand threads.





4. Screw the cup until only about 5mm of thread is outside of the bottom bracket.
5. Find the position key slow and push the sensor backward to fit. When the key is linked the cable will move with the movement of sensor. If there is no movement the key isn't linked.





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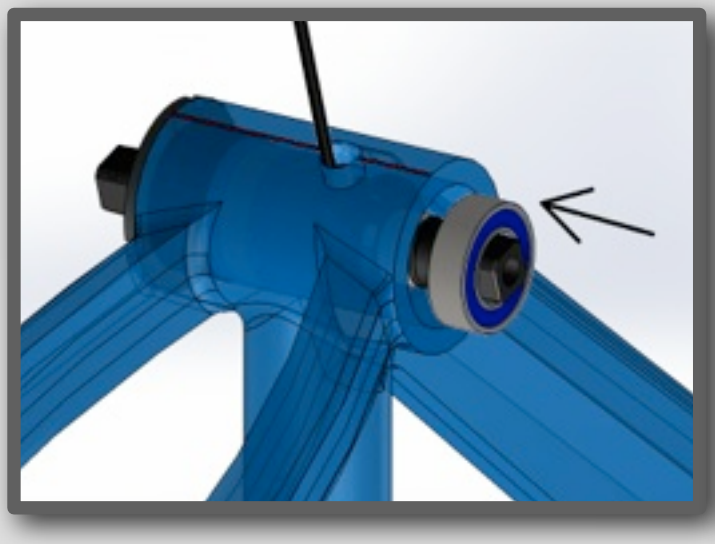
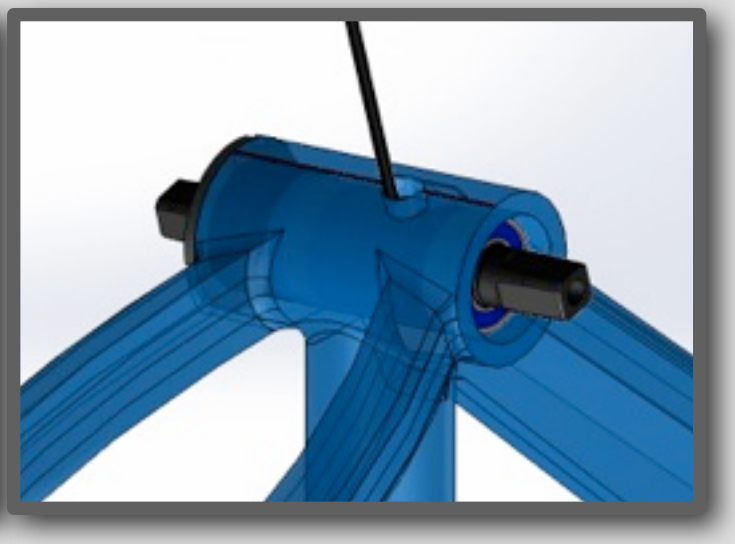
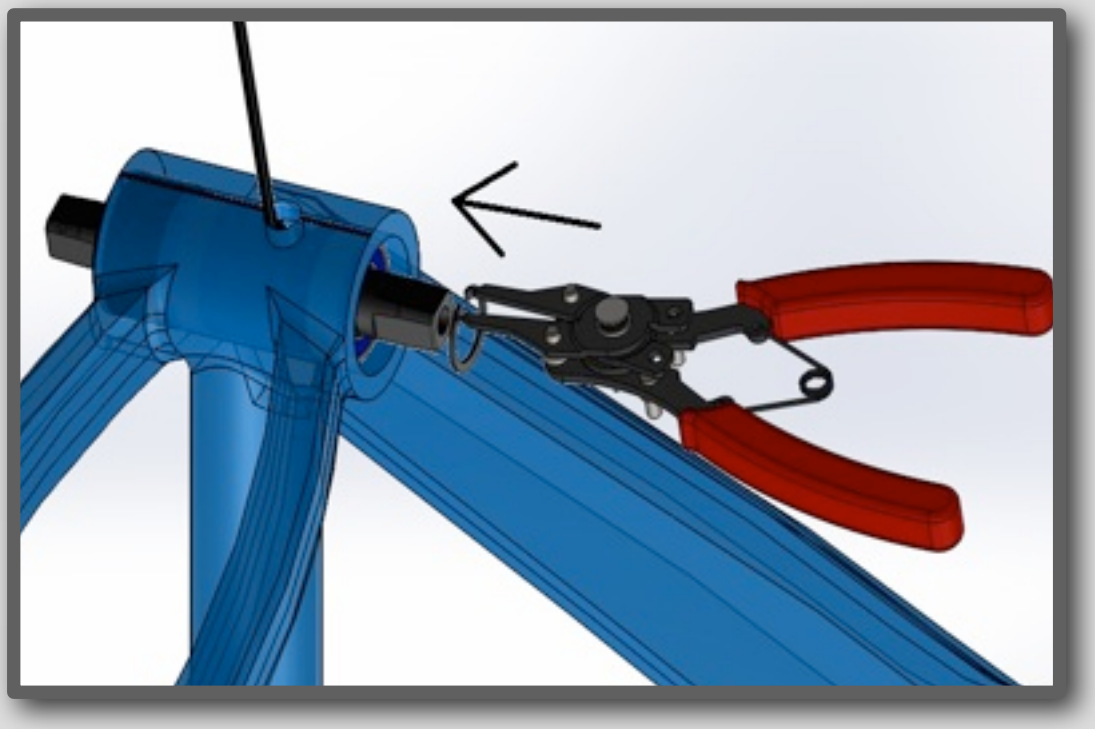
Installation of the rotor bearing





1. Simply insert rotor bearing into position and using external snap ring pilers place snap ring into position to hold the bearing.



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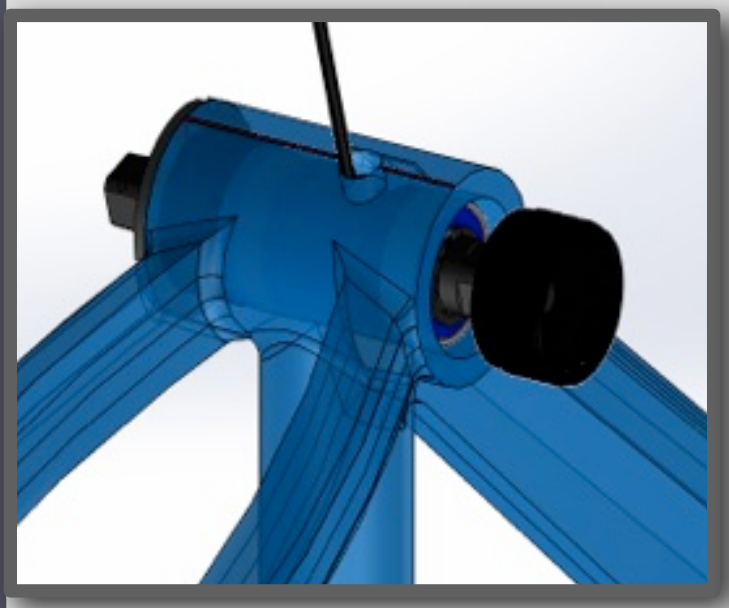
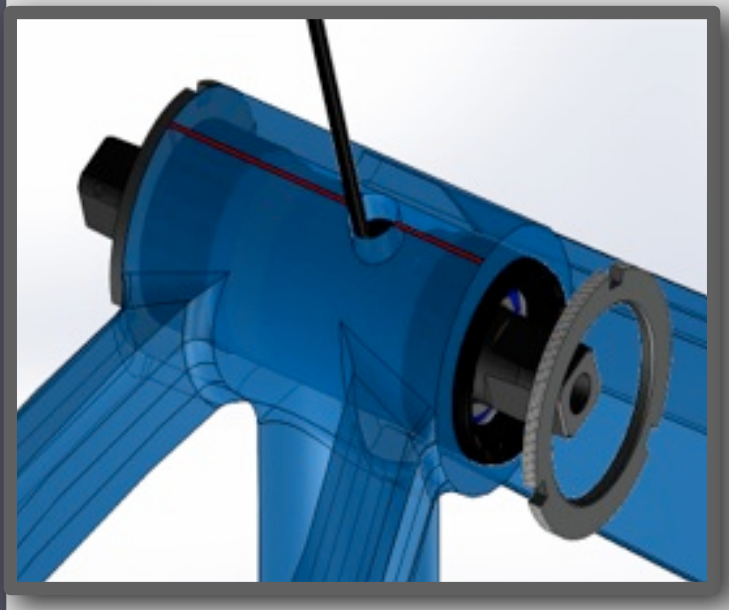
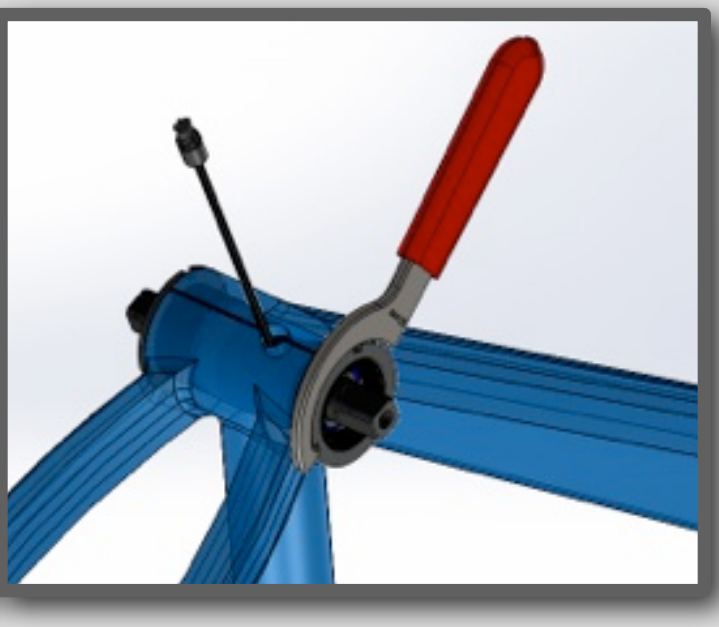
Installation of left side adjusting cap



1. Screw the left side cup clockwise into the bottom bracket shell.
2. Ensure the cups are both tightly secured.
3. Optimum tightness is around **70 Nm**. It is recommended the caps are first tightened to 60 Nm and then slowly adjusted.

Installation of left and right lock ring





1. Tighten left side lock ring onto cup and tighten until it is secure against bottom bracket shell. Repeat for the right side.

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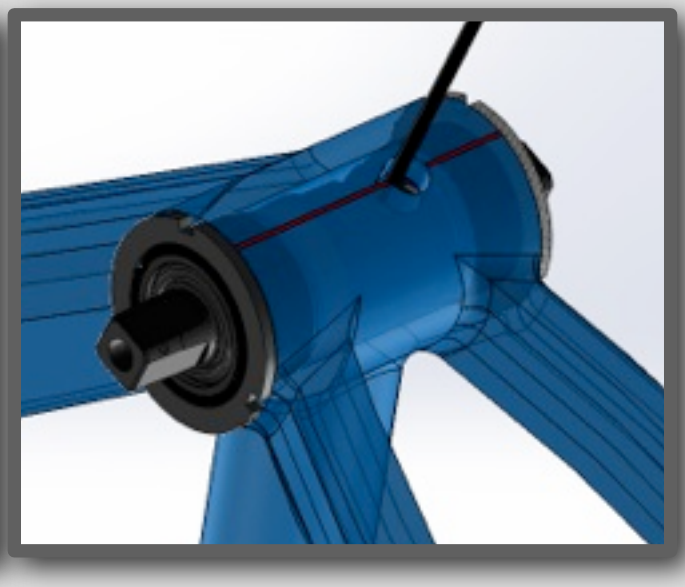
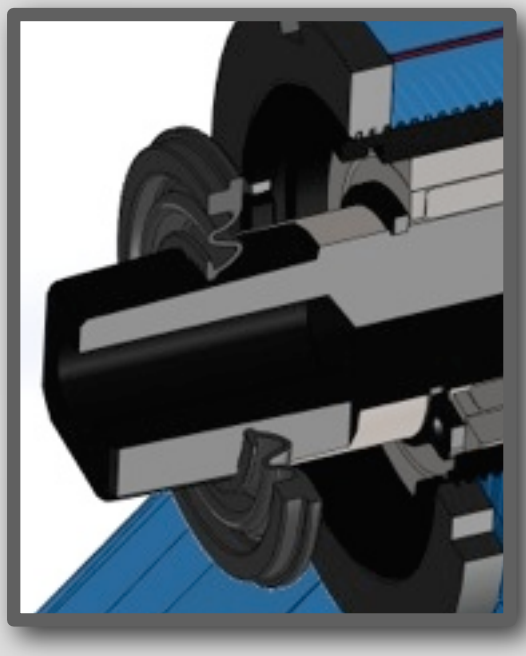
Installation of rubber dust seal

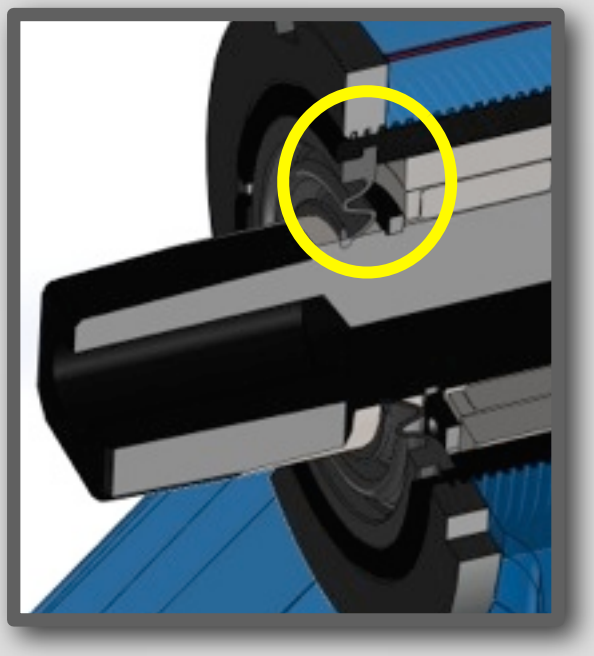


1. Install the rubber dust seal from by sliding it over the Torque Sensor Shaft from the right side.

2. Insure that the inside diameter of the rubber Dust Seal nests into the outermost grove on the Torque Sensor Shaft

3. Ensure that the outside diameter of the rubber Dust Seal nests in the grove on the inner diameter of the Right Side Adjusting Cup





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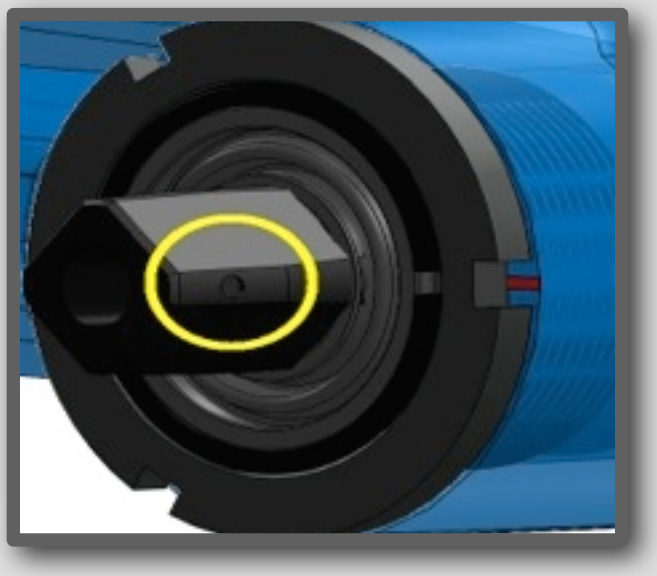
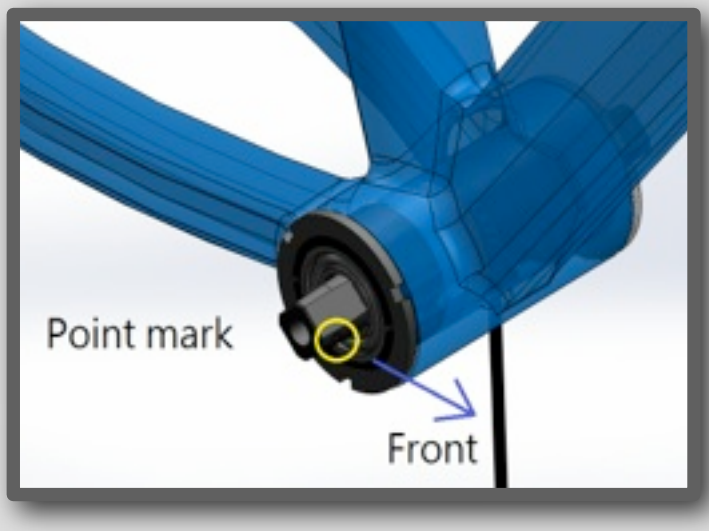
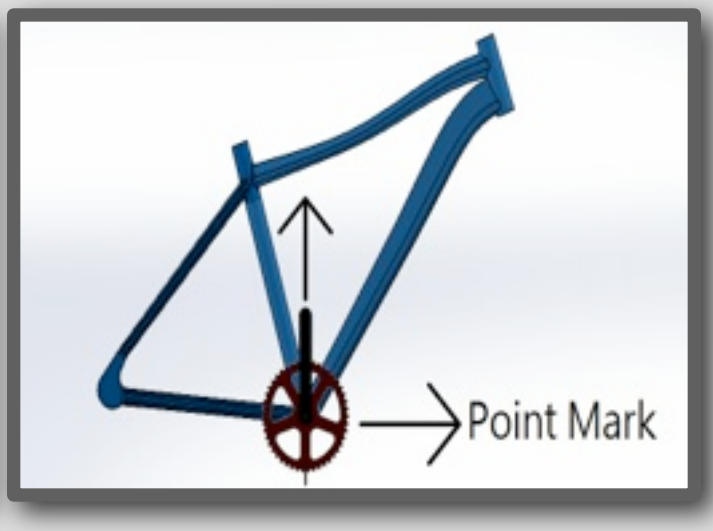
Installation of crank position



1. Turn the spindle until the dented round dot (see yellow circle) is in line with the horizontal make made earlier.
2. Insert right crank in upwards position
3. Insert opposite side crank





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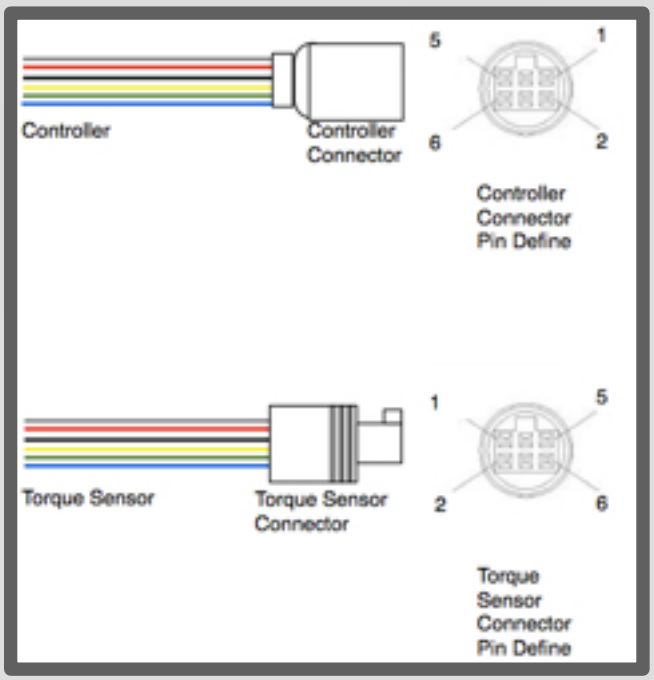
Measuring Torque and Position Output



1	Left-right foot signal
2	+5 VDC
3	GND
4	CoSine signal S2
5	Torque
6	Sine signal S1

Signal check after mechanical installation

1. Connect the mating connectors

2. Connect + 5V (red) and GND (black) to power supply.

3. Check output of torque signal using a multimeter set to V (dc). The reading on the torque should be between 2.4 and 2.6V**

4. Hand turn the spindle checking the left & right signal (white) is working. It should give 5V and 0V signals as rotated, changing every 30°.

5. Hand turn the spindle checking both sine and cosine signals (blue and yellow) are working. Again it should give 5V and 0V signals, changing through every half turn.

** If output isn't within or very close to this range, please look at the installation of the sensor. The most common mistake is made by not accurately determining the horizontal position on the bottom bracket, as on page 11. With this horizontal position double checked please then ensure the postion key on page 13 is then also in the right position (in line with the horizontal mark).

If there are any further signal anomalies please contact sales@tdcm-motor.com.

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Measuring the maximal torque and position output

1. Install chain
2. Connect the mating connectors
3. Connect + 5V (red) and GND (black) to power supply.
4. Place left peddle forwards and parallel to the ground.
5. Check the crank position signal (white wire)
6. Hold the brake tight and stand or place 35 kg weight on the peddle.
7. Measure the torque out (green wire) to record the maximal output (approximately 3.4V).
8. Repeat procedure 4-5 for right peddle.

If there are any further signal anomalies please contact sales@tdcm-motor.com.

Notes

1. Starting voltage should be between 2.6 - 2.3 with over 0.8V working range
2. Left and right signal may not be identical. Controllers should have the ability to proportionate the output.
3. Ghost riding phenomenon may occur. Controller software should be able to overcome this.
4. Backward peddle might generate torque sensor output.
5. If torque output is less than 0.8V, please ensure the tightness of the snap rings are tight against the bottom bracket device.

TDCM

HIGH PERFORMANCE PROPULSION

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