

## MS1-Extra and MS2-Extra

Many engines can benefit from having a wasted spark setup over a distributor, the gains in timing accuracy (crank timing signal) and the longer charge time available at higher RPM's can gain a few extra horses. Some setups have a crank signal or a cam signal but still use a distributor to sort out which cylinders to fire. The same theory applies for these as a wasted setup (same amount of Trig Positions as a wasted setup), BUT you only set **SparkA output** for **MS1-Extra** (**NOT Spark B**, etc) in the **output functions** or in **MS2-Extra** you set the **Number of Coils to Single** in **Ignition Options**.

*(Note: All that would have been done for you when purchasing through [www.ExtraEFI.co.uk](http://www.ExtraEFI.co.uk))*

Most modern engines will have a crank signal, either a 36-1 (Ford) or a 60-2 (Bosch) or similar setup. If you don't have a suitable signal or if the engine was a distributor based setup then the easiest method to go over to wasted spark is to fit a 36-1 wheel on the crank pulley and a Ford VR sensor. These are readily available from companies such as [www.trigger-wheels.com](http://www.trigger-wheels.com). Of course there are other methods, such as a 60-2 crank, 12-1, etc, etc. Even a cam signal with 2 missing teeth at 180deg apart and equally spaced teeth between can be used for wasted spark (Cam rotates at half the crank speed). The only disadvantage of a cam signal is that there will be a small inaccuracy with timing due to gear backlash, belt or chain slack, etc.



36-1 wheel (space for 36 teeth but 1 missing, so 35 in total)

The easiest method to fire **COPs** (Coil on Plug) is in a **wasted spark** format, this requires a simple crank signal as above, or a cam signal. Then we simply fire them in pairs as per a wasted spark setup.

For a **sequentially fired COP** setup you must have a suitable cam signal, as firing on a 4 stroke is repeated over 720deg of the crank and 360deg of the cam, so a cam signal must be used to sync it:

- \* Missing tooth wheel at cam speed
  - \* Missing tooth wheel at crank speed + single tooth at cam speed
  - \* Non-missing tooth wheel at crank speed + single tooth at cam speed
  - \* Non-missing tooth wheel at cam speed + single tooth at cam speed
- The cam signal could be as simple as a magnet on the timing pulley and a hall sensor in proximity to it. Most of these require a second input signal on the ECU, this would have been discussed during the ordering stage if you asked for a sequentially fired COP setup.

So lets assume your going to fit a 36-1 wheel, the VR sensor (Crank sensor) **MUST** line up with the teeth at 0.75-1.0mm on every tooth, so getting the wheel fitted squarely so it doesn't move up, down, left or right is critical! Also making the sensor bracket so its slightly adjustable would be an advantage. (Mark it once its running incase you have to remove it) The missing tooth is tooth ZERO (the first missing tooth on a 60-2) and subsequent teeth are then counted. Whilst its not that important which tooth the sensor lines up with when the engine is at TDC I recommend that it's lined up with the same tooth as an EDIS setup would be, so:

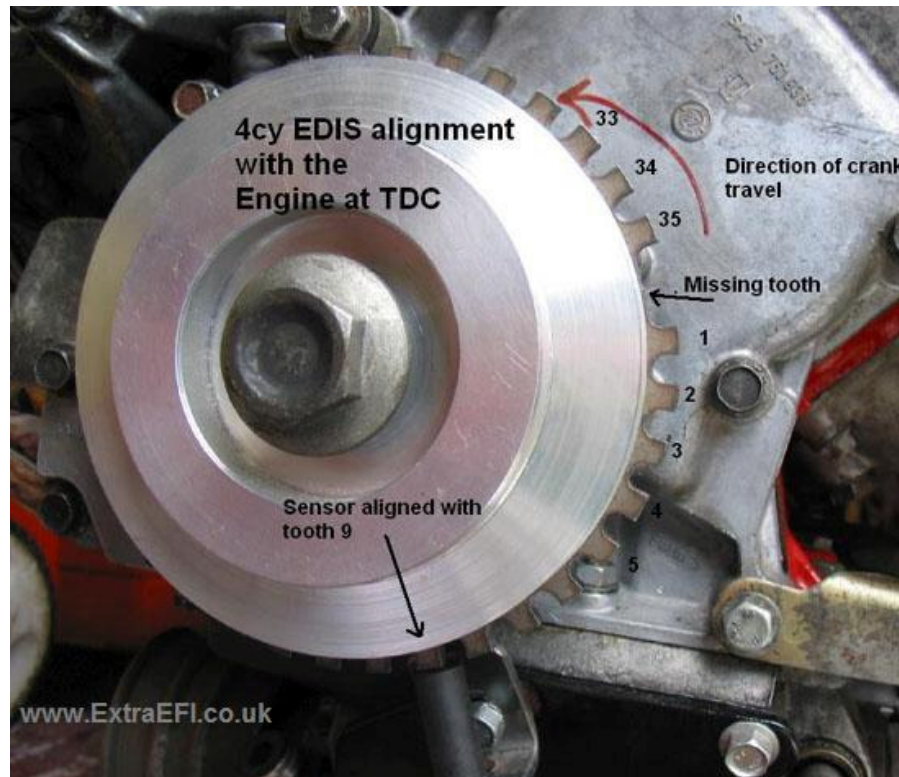
**4cy = tooth 9,**

**6cy = tooth 6,**

**8cy = tooth 5**

*(Ensure you know the direction of rotation for your engine)*

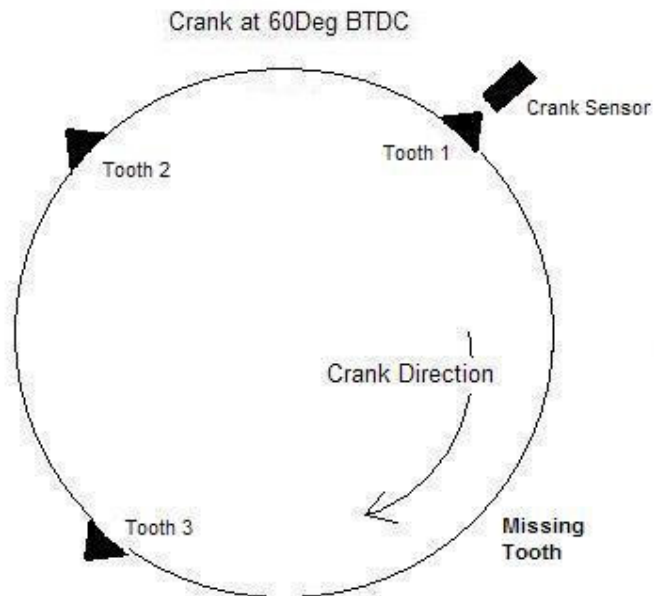
*Direction of rotation for this example is Anti-Clockwise*



If you haven't aligned the sensor with the above tooth don't worry, all is not lost, but you must find out which tooth is aligned when the engine is at TDC to work out the values to enter into MegaTune. The reason for using the same teeth as EDIS is that its easy for me to document and, if you need to, you can fit an EDIS module to test certain parts of the system.

If your using another style of tooth, e.g. 4-1 (1 tooth every 90deg with 1 missing) then you will need to fit the wheel so tooth 1 lines up with the sensor at around 60deg BTDC. A 4-1 would be minimum for a 4cy, a 6-1 wheel (tooth every 60deg with 1 missing) would be minimum for a 6cy, 8-1 (tooth every 45deg) for an 8cy, etc.

### 4-1 Trigger Wheel 4 teeth equally spaced (90deg apart) with 1 tooth missing, so 4-1



Tooth 1 lines up with the sensor at 60Deg BTDC

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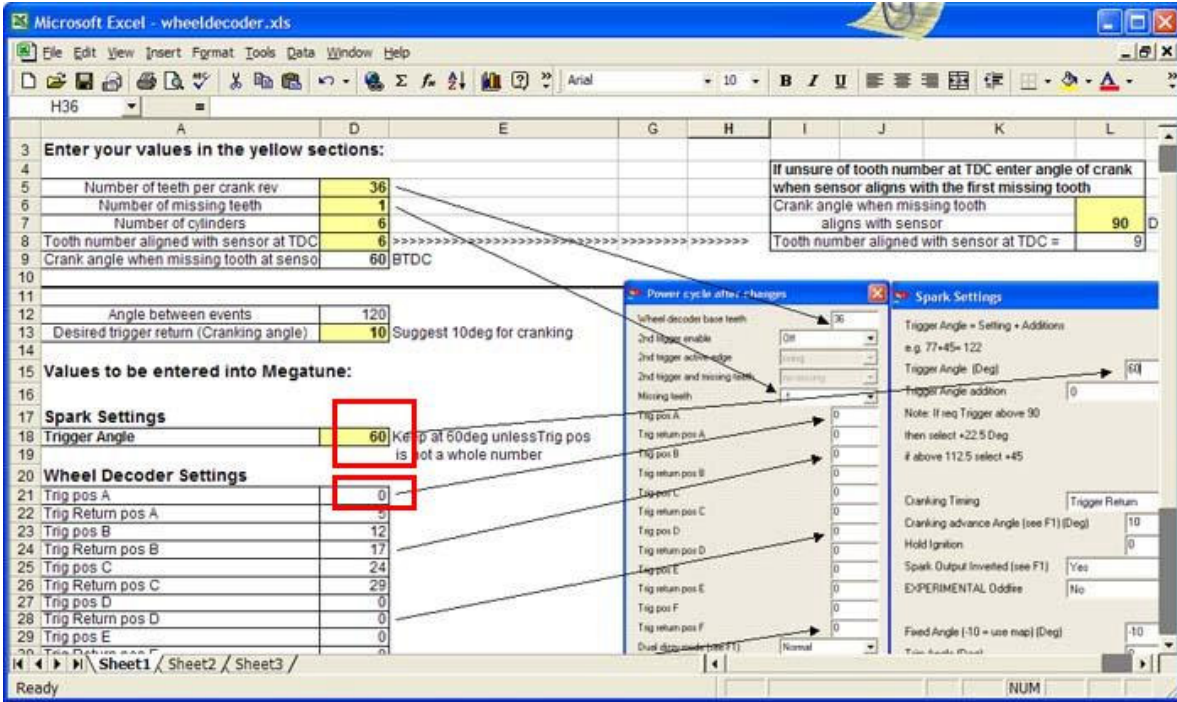
## (Wasted Spark) MS1-Extra ONLY

for MS2 see [BELOW](#)

*Please Note, if you have told me about your setup when purchasing then I will have done all this for you, this is only necessary if you fitted your own wheel without letting me know which tooth is at the sensor at TDC. For standard setups, e.g. Ford, BMW, etc, then this*

will have been done. If you had something odd that I wasn't sure about then you will need to check these settings.

Now we have the sensor mounted and we know which tooth is aligned with the sensor when the engine is at TDC. In our example we have a 6cy engine and tooth 6 is lined up with the sensor at TDC. So we enter this info into the [wheeldecoder.xls](#)



A 6cy engine running wasted spark will have 3 spark triggers/crank revolution, so we will use **Trig A, B and C**. A 4cy wasted running wasted will have 2 spark triggers so will use **Trig pos A and B**, an 8cy running wasted spark will use **Trig pos A,B,C and D**, etc.

The above setup brings up a problem in that **Trig pos A is ZERO**. A **ZERO is NOT ALLOWED** in a used **Trig Position!** So to get around this we must change the **Trigger Angle**, set this to 50deg and try again. (This could have been increased to 70deg, see below)

The screenshot shows the 'wheeldecoder.xls' spreadsheet with the following data:

Input	Value
Number of teeth per crank rev	36
Number of missing teeth	1
Number of cylinders	6
Tooth number aligned with sensor at TDC	6
Crank angle when missing tooth at sensor	60 BTDC
Angle between events	120
Desired trigger return (Cranking angle)	10 (Suggest 10deg for cranking)
Trigger Angle	50
Trig pos A	1
Trig Return pos A	5
Trig pos B	13
Trig Return pos B	17
Trig pos C	25
Trig Return pos C	29
Trig pos D	0
Trig Return pos D	0
Trig pos E	0
Trig Return pos E	0
Trig pos F	0
Trig Return pos F	0

*Note: As the ECU needs around 10deg to calculate the firing angle the Trigger Angle needs to be 10deg more than the maximum advance your engine will ever need, so 50 is about as low as you can go, unless you go to Zero degs, but theres no point in that when you have multiple teeth. Ideally you need to be around 50-70deg for the Trigger Angle. You can't use say 30deg for a Trigger Angle as the maximum usable advance would only be  $30 \text{ (Trig Angle)} - 10 \text{ (Time to calculate)} = 20\text{deg}$ , which isn't enough for most engines. Rather than 50deg a angle of 70deg could have been used.*

So with 50degs set we have a setting of tooth "1" for the **Trig pos A**, note that **Trig pos A, B and C** have increased by one, this is because the trigger angle has changed by 10deg, which is the same as one tooth space on a 36-1. If you were using a 60-2 then you would try reducing or increasing the Trigger Angle by 6deg (1 tooth on a 60-2) to get away from tooth Zero.

**Once you have the engine running you MUST check your timing with a strobe to ensure the angle in MegaTune corresponds to the ACTUAL fired angle. Alter the Trigger Angle until it is the same!!!**

# (Sequential COP)

max size = 6cy using MS1-Extra

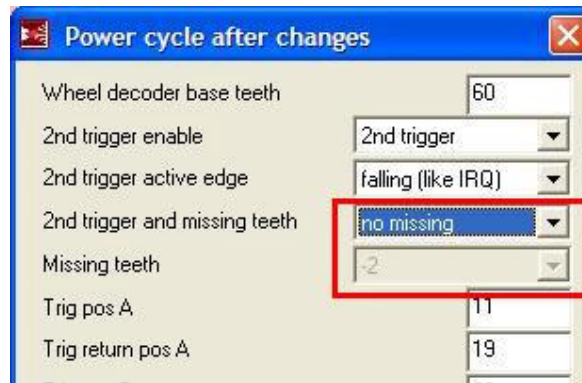
## MS1-Extra ONLY

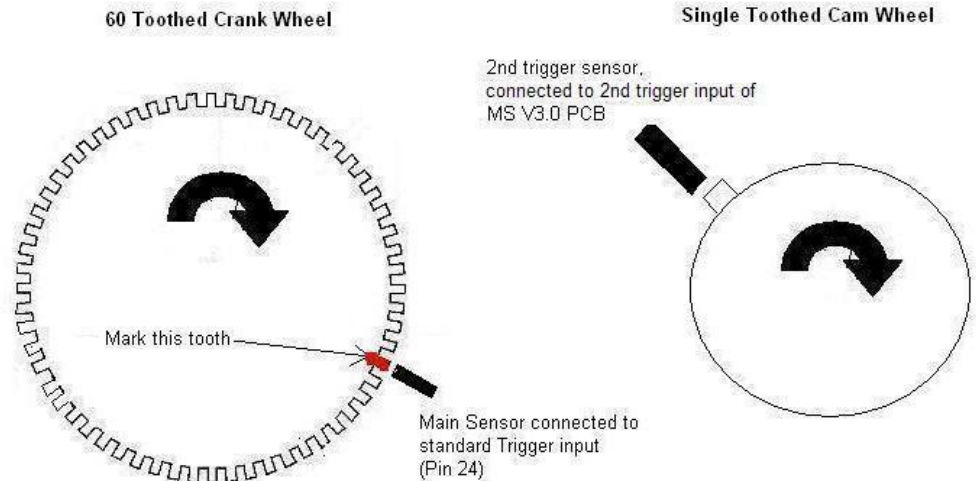
for MS2 see [BELOW](#)

*Please Note, if you have told me about your setup when purchasing then I will have done all this for you, this is only necessary if you fitted your own wheel without letting me know which tooth is at the sensor at TDC. For standard setups, e.g. Ford, BMW, etc, then this will have been done. If you had something odd that I wasn't sure about then you will need to check these settings.*

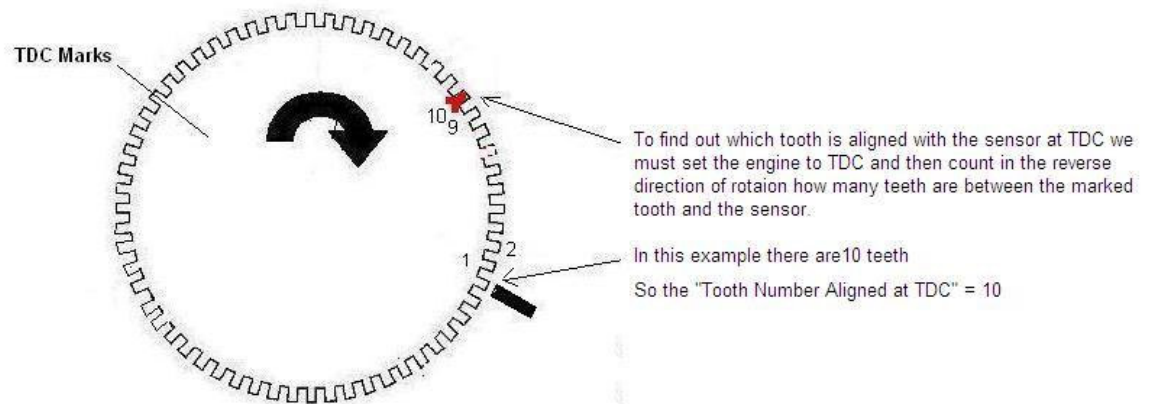
For a sequentially fired COP setup we have to have a suitable cam signal and a crank signal, the crank signal can come from the cam as long as its repeated every crank rotation, so repeated twice per cam rotation. (*remember the cam rotates at half the crank speed*)

**Tooth One** is the next tooth on the **crank** that is seen after the **Single Cam pulse**. In this example we are using a crank signal without any gaps, equally a 60-2 could be used or a 36-1, etc, simply change this setting in **MegaTune - Wheel Decoder Settings**:





The cam wheel tooth has just passed the sensor, so we need to mark the tooth that is aligned up next at the main wheel. This is Tooth Number ONE



So now we know which tooth is aligned at TDC we need to set the Trigger Angle to around 60deg and figure out which tooth the sensor will see at 60deg BTDC. We need to know how many degrees between each tooth of the crank wheel, so on a 60-2 or a 60 toothed wheel it will be  $360/60 = 6\text{deg}$  or a 36-1 will be  $360/36 = 10\text{deg}$ .

***Note: As the ECU needs around 10degs to calculate the firing angle the Trigger Angle needs to be 10deg more than the maximum advance your engine will ever need, so 50 is about as low as you can go, unless you go to Zero degs, but theres no point in that when you have multiple teeth. Ideally you need to be around 50-70deg for the Trigger Abgle. You can't use say 30deg for a Trigger Angle as the maximum usable advance would only be  $30 (\text{Trig Angle}) - 10 (\text{Time to calculate}) = 20\text{deg}$ , which isn't enough for most engines. Rather than 50deg a angle of 70deg could have been used.***

So in our example we need to know what tooth will align at 60deg BTDC (The **Trigger Angle**), we know that tooth **10** aligns at TDC, so 60deg before that point would be 10 more teeth (as a 60 toothed wheel has a gap of 6deg between teeth), this means tooth **20** will line up with

the sensor at 60deg BTDC (Trigger Angle).

Assuming a 4 stroke setup:

On a 2cy engine we will fire a plug every 360deg of the crank, on a 4cy engine every 180deg of the crank and on a 6cy we will fire every 120deg of the crank.

So for our example of a **4cy setup** we fire every **180deg** of the crank, which is **30** teeth (using a **60 toothed** crank wheel). So **Trigger B** position will be **30** teeth after **Trigger A Pos**;

**Trig Pos A = 20**

**Trig Pos B = 50**

A 6cy setup with the wheel in the same place would be 120deg between trigger positions, which is 20 teeth:

**Trig Pos A = 20**

**Trig Pos B = 40**

**Trig Pos C = 60**

**Once you have the engine running you MUST check your timing with a strobe to ensure the angle in MegaTune corresponds to the ACTUAL fired angle. Alter the Trigger Angle untill it is the same!!!**

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## (Wasted Spark)

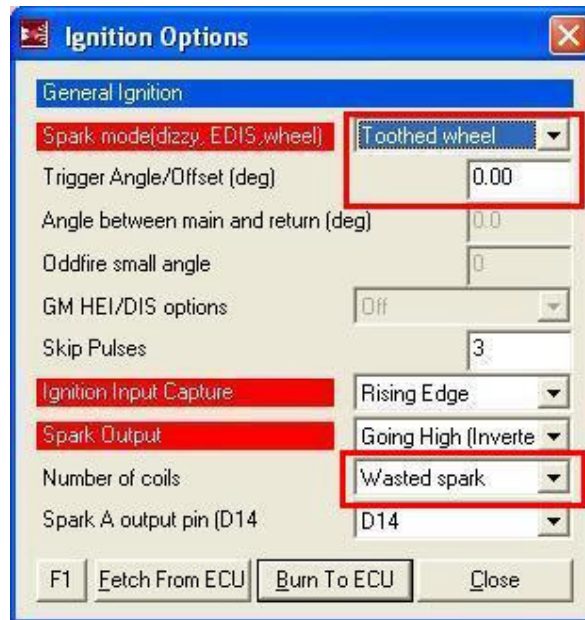
# MS2-Extra ONLY

for MS1 see [ABOVE](#)

*Please Note, if you have told me about your setup when purchasing then I will have done all this for you, this is only necessary if you fitted your own wheel without letting me know which tooth is at the sensor at TDC. For standard setups, e.g. Ford, BMW, etc, then this will have been done. If you had something odd that I wasn't sure about then you will need to check these settings.*

In **MS2-Extra** the **Trigger Angle/Offset** is ignored in **Toothed Wheel mode**, so leave it set at **zero**. The angle used now is the angle that **Tooth #1** passes the sensor at, this is set in **Trigger Wheel Settings**.

For **wasted spark** (including **COP** running wasted spark format) ensure the **Number of Coils** is set to "**Wasted Spark**"



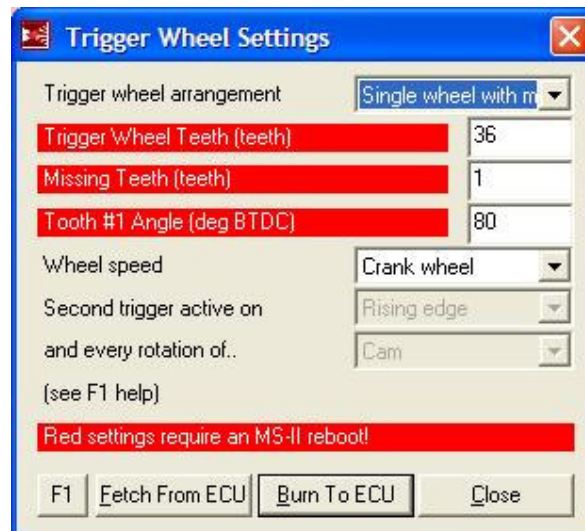
If you are unsure what the angle will be then simply work out the angle between each tooth and find which tooth lines up at TDC. Then count back to tooth 1 and multiply that value with the angle between each tooth.

e.g. Typical 4cy Ford Setup

**36 -1 setup is 10deg between teeth ( $360\text{deg} / 36 \text{ teeth} = 10\text{deg}$ )**

**Tooth 9 lines up with sensor at TDC, so tooth 9 to tooth 1 = 8 teeth**

**Therefore 8 teeth x 10deg = 80deg (Tooth #1 Angle)**

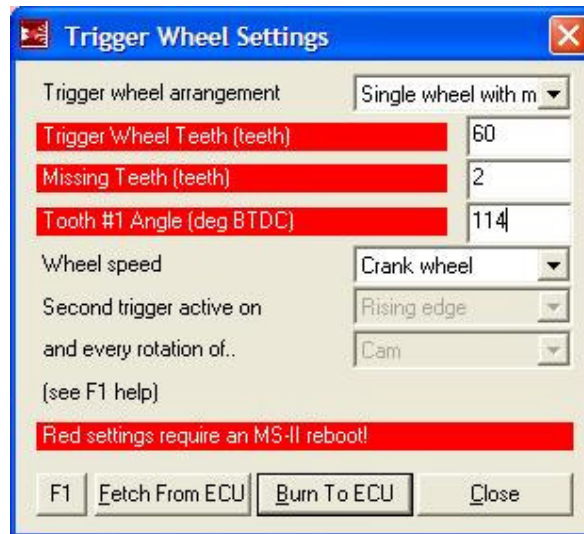


Typical Peugeot setup

**60-2 setup is 6deg between teeth ( $360\text{deg} / 60 \text{ teeth} = 6 \text{ deg}$ )**

**Tooth number 20 lines up with sensor at TDC, so tooth 20 to 1 = 19 teeth**

**Therefore 19 teeth x 6deg = 114deg (Tooth #1 Angle)**



If you fitted the 36-1 wheel as our example [above](#) then on a 6cy setup you will have set the sensor to see tooth 6 at TDC. This means that tooth 1 will be 5 teeth previous:

**36 -1 setup is 10deg between teeth ( $360\text{deg} / 36 \text{ teeth} = 10\text{deg}$ )**  
**Tooth 6 lines up with sensor at TDC, so tooth 6 to tooth 1 = 5 teeth**  
**Therefore 5 teeth x 10deg = 50deg (Tooth #1 Angle)**

For a 4cy using the [above](#) 36-1 setup (tooth 9) it will be:

**36 -1 setup is 10deg between teeth ( $360\text{deg} / 36 \text{ teeth} = 10\text{deg}$ )**  
**Tooth 9 lines up with sensor at TDC, so tooth 9 to tooth 1 = 8 teeth**  
**Therefore 8 teeth x 10deg = 80deg (Tooth #1 Angle)**

For an 8cy using the [above](#) 36-1 setup (tooth 5) it will be:

**36 -1 setup is 10deg between teeth ( $360\text{deg} / 36 \text{ teeth} = 10\text{deg}$ )**  
**Tooth 5 lines up with sensor at TDC, so tooth 5 to tooth 1 = 4 teeth**  
**Therefore 4 teeth x 10deg = 40deg (Tooth #1 Angle)**

**Once you have the engine running you MUST check your timing with a strobe to ensure the angle in MegaTune corresponds to the ACTUAL fired angle. Alter the Angle #1 until it is the same!!!**

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# (Sequential COP) MS2-Extra ONLY

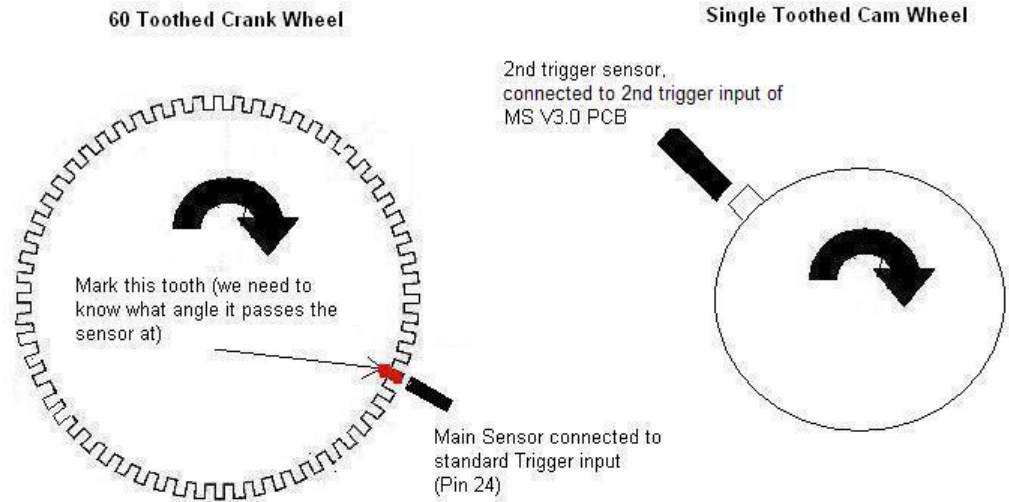
*max size = 4cy using MS2-Extra*

for MS1 see [ABOVE](#)

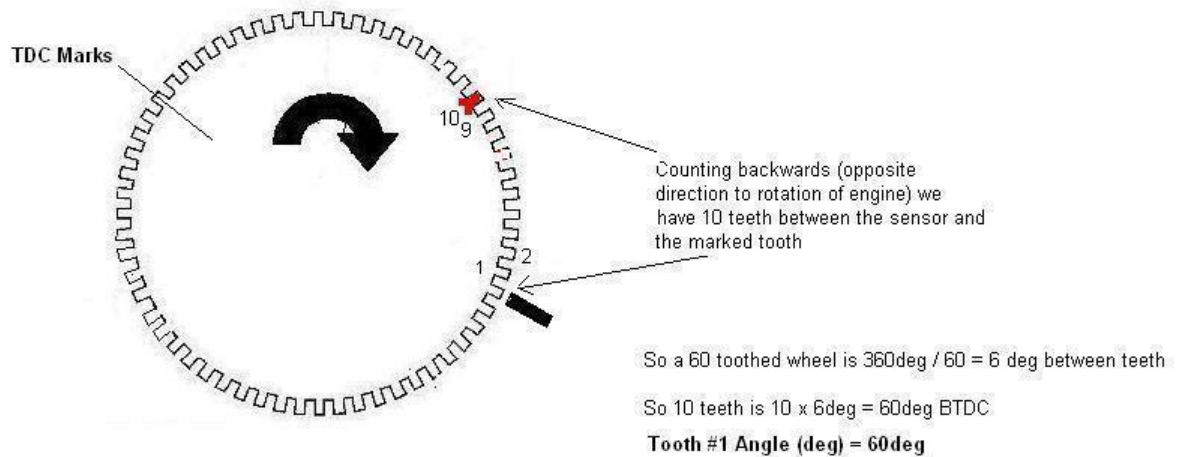
*Please Note, if you have told me about your setup when purchasing then I will have done all this for you, this is only necessary if you fitted your own wheel without letting me know which tooth is at the sensor at TDC. For standard setups, e.g. Ford, BMW, etc, then this will have been done. If you had something odd that I wasn't sure about then you will need to check these settings.*

In **MS2-Extra** the **Trigger Angle/Offset** is ignored in **Toothed Wheel mode**, so leave it set at **zero**. The angle used now is the angle that **Tooth #1** passes the sensor at, this is set in **Trigger Wheel Settings**.

For **sequential COP** ensure the **Number of Coils** is set to "COP"

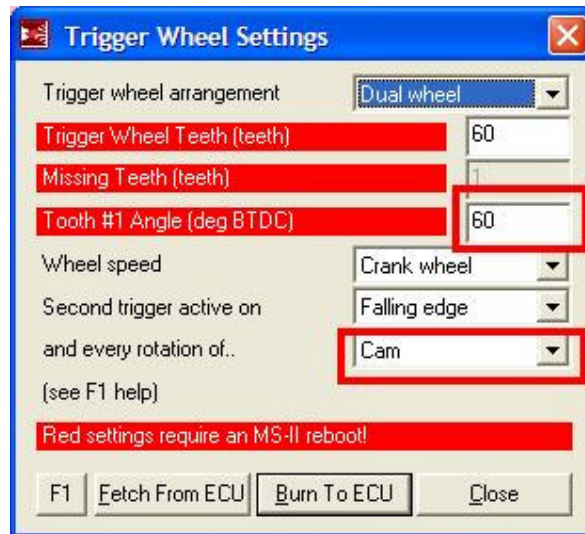


- 1 The cam wheel tooth has just passed the sensor, so we need to mark the tooth that is aligned up next at the main wheel.
- 2 Then we can set the engine to TDC and count back from the sensor to the marked tooth.



If you are unsure what the angle will be then simply mark the tooth on the main wheel that is seen after the 2nd trigger pulses. Work out the angle between each tooth and find which tooth lines up at TDC. Then count back to the marked tooth and multiply that value with the angle between each tooth.

In the above 60 tooth setup you can see that at TDC the sensor is 10 teeth from the marked tooth (the marked tooth is the tooth that is seen just after the single **cam** pulse), this means 10 teeth at 6degs per tooth = **60deg**



Note: Second Trigger would be **CAM** in this example

e.g.

Typical Peugeot setup:

**60 toothed wheel setup is 6deg between teeth ( $360\text{deg} / 60 \text{ teeth} = 6 \text{ deg}$ )**

**Assuming its 19 teeth away then  $19 \times 6\text{deg} = 114\text{deg}$  (Tooth #1 Angle)**

**36 toothed wheel setup is 10deg between teeth ( $360\text{deg} / 36 \text{ teeth} = 10\text{deg}$ )**

**Mark the tooth that's seen just after the 2nd trigger tooth (CAM) comes on.**

**Turn the engine to TDC and count teeth backwards from the sensor to the marked tooth.**

**Assuming its 8 teeth then  $8 \times 10\text{deg} = 80\text{deg}$  (Tooth #1 Angle)**

**Once you have the engine running you MUST check your timing with a strobe to ensure the angle in MegaTune corresponds to the ACTUAL fired angle. Alter the Angle #1 until it is the same!!!**

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