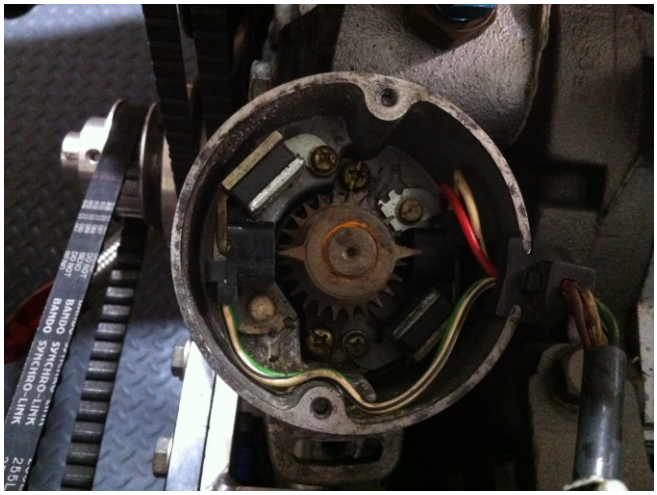
How to setup your Rotary Engine in FuelTech FT 350/400

The FuelTech electronic fuel injection system can be used to control fuel and ignition in Mazda Rotary Engines (2 and 3 rotors) using the stock Crank Angle Sensor used in 2nd Generation Mazda RX-7 1986 to 1991. This step by step document will guide engine tuners to configure the ECU to be used with your rotary engine, taking advantage of all FuelTech functions. The Crank Angle Sensor set up for the 3 rotor is the same as the 2 rotor. Any difference in the setup between the two configurations will be noted.

A quick note is that **FT350 controls only 2 rotor engines**; **FT400 controls 2 and 3 rotor engines.**

Understanding your Rotary Engine Crank Angle Sensor



The crank angle sensor (CAS) has two (2) trigger wheels that provide different signals to the ECU. As shown in picture above the bottom one is a 24 tooth wheel that provide the RPM signal and position of the eccentric shaft. The top trigger wheel is a 2 tooth wheel that provides information of the position of the rotor. The crank angle sensor rotates at half speed of the eccentric shaft, this mean that a crank angle sensor degree is equal to two (2) eccentric shaft degrees. A home signal will be send by the 2 tooth wheel every 12 tooth of the bottom wheel. Every signal of the 2 tooth wheel will be equal to 360° of the eccentric shaft.

FuelTech ECU will control the ignition timing using the reference of the 24 tooth wheel to spark the leading coil. All ignition timing programmed in the tables is referenced to the leading coil. Trailing coil will be fired using the programmed timing split parameter. This means that if the ignition timing in the main table is 0° and timing split is 10 °, the ECU will fire the leading coil at 0° and the trailing coil 10° after leading coil was fired. The timing split parameter is fixed across all the ignition timing range.

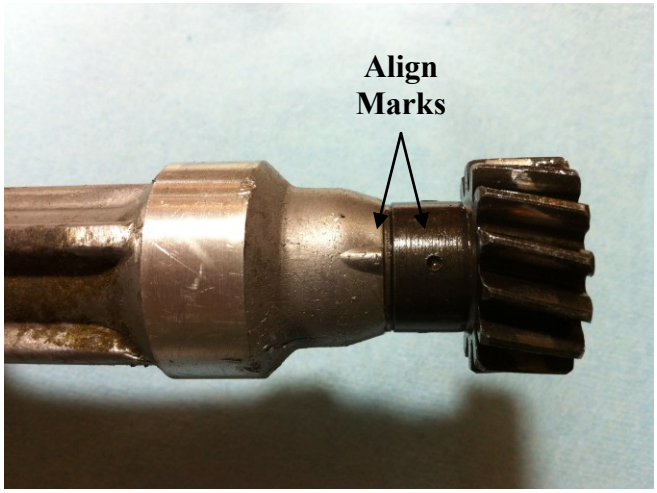
The eccentric shaft needs to rotate 3 times to complete a full rotation of a rotor. In a 2 rotor engine the front rotor leads the second rotor by 180° in the eccentric shaft. Therefore, an ignition event will occur every 180° of the eccentric shaft. An ignition event will occur every 60° of the rotor. In a 3 rotor engine the front rotor leads the second and third rotor by 120°. An ignition event will occur every 40°. The 2 tooth wheel will be used to know which rotor will be fired.

Installation of the Crank Angle Sensor

The Crank Angle Sensor needs to be installed in the engine at 0° (top dead center position). Use the following step by step guide.

1. Use your ignition timing marks in the damper to align the eccentric to TDC. The ignition timing mark to be used is shown below.

2. Align the Crank Angle Sensor to 0° using the mark in the shaft.



3. Install the Crank Angle Sensor in the engine and tighten to the timing cover. After complete the above steps correctly the Crank Angle Sensor should be aligned at TDC with the eccentric shaft.

Wring of the Crank Angle Sensor

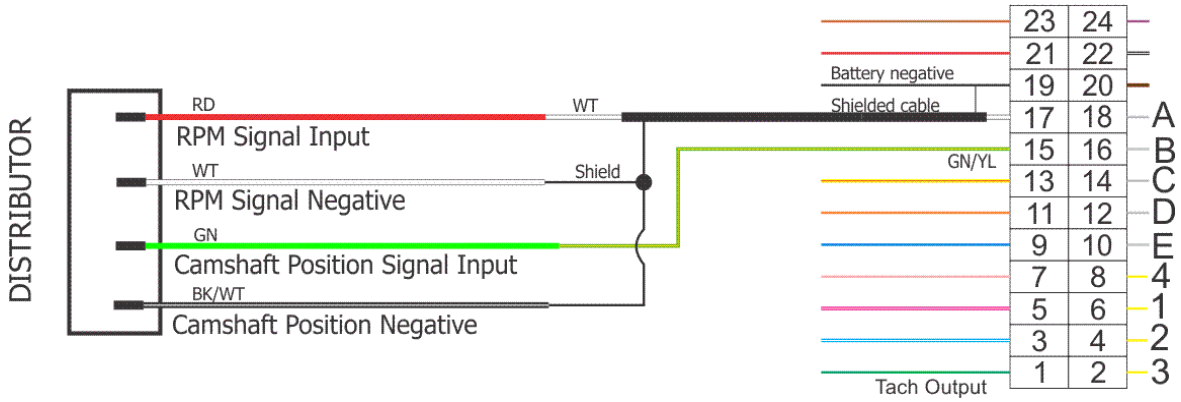
The rotary engine crank angle sensor will be configured like a crank trigger and camshaft position sensor in FuelTech ECU. The installation manual has a wiring diagram for a Rotary Engine; these instructions will complement the wiring diagram included in the installation manual.

The shielded cable from FuelTech has 2 wires; the white wire is the RPM signal and the shield is the negative. The negative wires of the Crank Angle Sensor (white and white/black wires) can be connected to the shield of the shielded cable from FuelTech.

The green wire of the CAS is the "Cam Sync Signal" output and should be connected to the Green/Yellow wire from FuelTech harness.

The last cable is the White wire of the CAS that is connected to the white wire from FuelTech shielded cable. Remember that the white wire is not the same as the shield from FuelTech shielded cable.

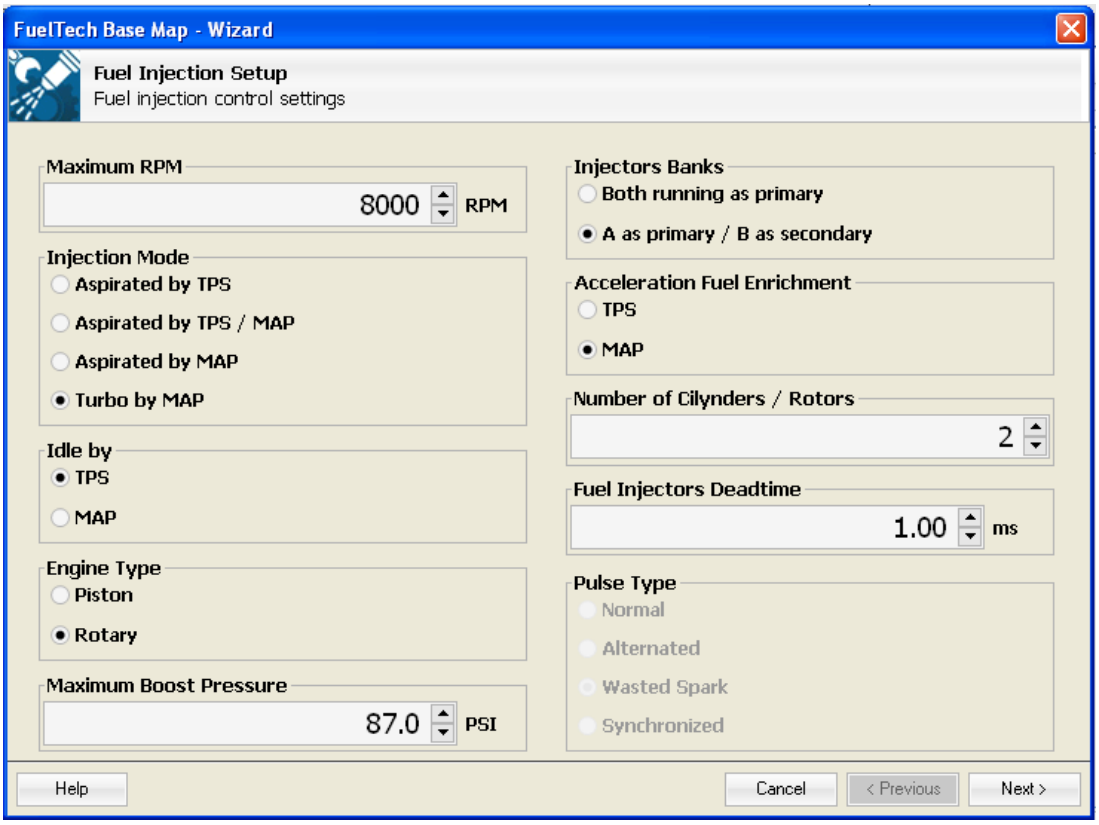
The scheme below shows these connections:



ECU Configuration and Setting for Rotary Engine

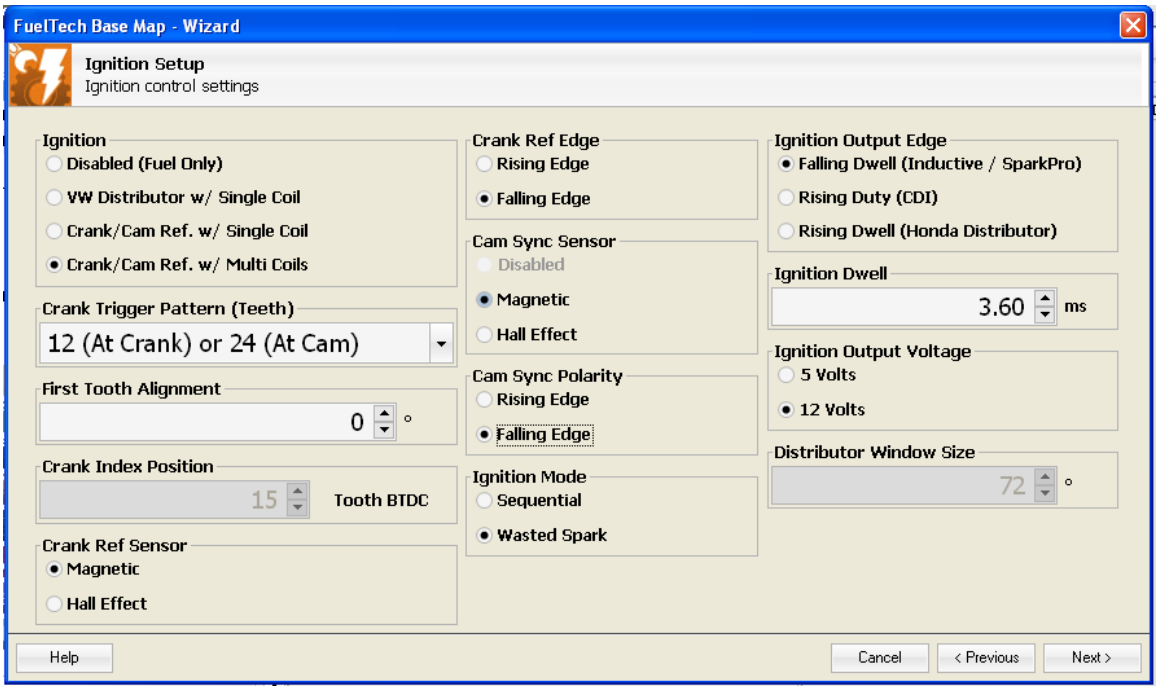
Use section 11 of the installation manual to configure and set up your ECU for the first time. Use the following step to configure the rotary engine Crank Angle Sensor.

1. Fuel Injection Setup – Select the fuel injection control setting that are more suitable for your rotary engine configuration. Make sure that you select **Rotary** in the engine type and the number of rotors **(2) or (3)** is the correct and click **Next**. The Crank Angle Sensor for 2 rotor and 3 rotor is the same, the selected number of rotors will make the difference in the control sequence of the ECU.



2. Ignition Setup – This will configure the Crank Angle Sensor and the Ignition System. The following table summarizes the control settings for the rotary engine Crank Angle Sensor. The most common ignition systems using by rotary engines are SparkPRO, MSD DIS2 and MW Rotary Versions. See Table 1 for the corresponding Ignition Output Edge of this Ignition Systems. Make sure that correct parameters are selected and click **Next.**

Parameter	Setting
Ignition	Crank/Cam Ref with multi coils
Crank Trigger Pattern	12 (at Crank) or 24 (at Cam)
First Tooth Alignment	0° (TDC)
Crank Reference Sensor	Magnetic
Crank Reference Edge	Falling
Cam Sync Sensor	Magnetic
Cam Sync Polarity	Falling
Ignition Mode	Wasted Spark

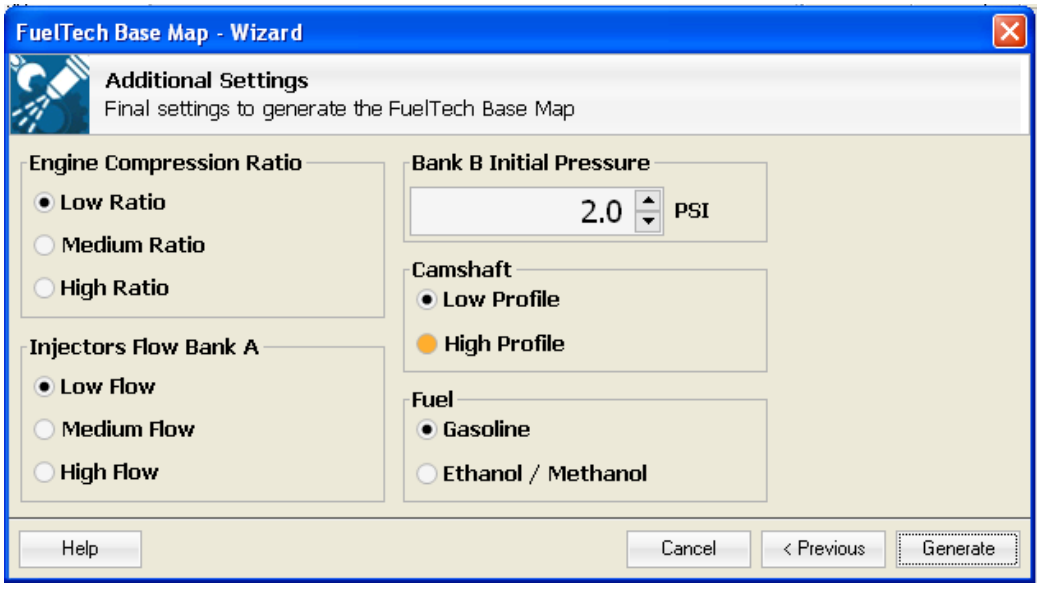


Ignition System	ECU Ignition Output Edge
SparkPRO	Falling Dwell
MSD DIS-2[(1)]	Rising Duty (CDI)
MW Pro-14/R[(2)]	Falling Dwell
MW-Pro Drag 4/R[(3)]	Falling Dwell

Notes:

1. Use two (2) ignition units
2. Considering that MW PRO-14/R trigger edge need to be configured as Falling Dwell leaving pins 9 to 10 unconnected. See page 9 of MW Ignition manual for more details
3. There is no set up the trigger edge of Pro-Drag 4/R. Trigger edge is Falling Dwell by default.

4. Additional Settings – Select the additional settings that are more suitable to your configuration and click **Generate.** The ECU will generate a base map for your configuration.



Wiring of the Ignition Coils

The wiring for the ignition coils is described in the wiring diagram included in the installation manual. Make sure that the correct ignition output wire of the ECU is connected to the corresponding ignition coil. If using SparkPRO Inductive Ignition System the ECU output will be the SparkPRO input as shown below.

2 Rotores (FT350 and FT400):

Bobina	ECU Ignition Output	SparkPRO
Leading Rotor 1	Ignition Output A	Ignition Output 1
Leading Rotor 2	Ignition Output B	Ignition Output 2
Trailing Rotor 1	Ignition Output C	Ignition Output 3
Trailing Rotor 2	Ignition Output D	Ignition Output 4

3 Rotores (FT400 only):

Bobina	ECU Ignition Output	SparkPRO
Leading Rotor 1	Ignition Output A	Ignition Output 1
Leading Rotor 2	Ignition Output B	Ignition Output 2
Leading Rotor 3	Ignition Output C	Ignition Output 3
Trailing Rotor 2	Ignition Output D	Ignition Output 4
Trailing Rotor 2	Ignition Output E	Ignition Output 5
Trailing Rotor 2	Ignition Output F	Ignition Output 6

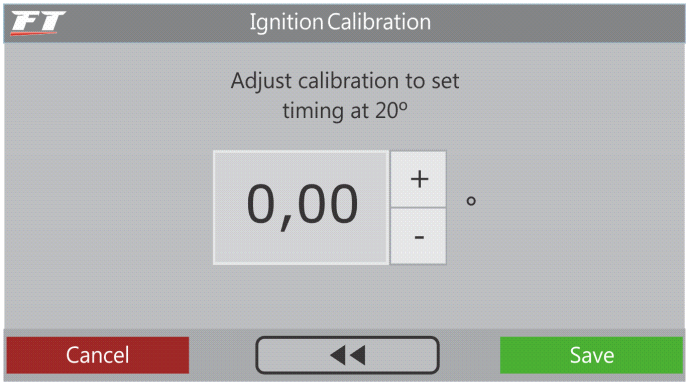
Calibration of the Crank Angle Sensor Ignition Timing

If all above steps were correctly completed it's time to crank the engine to start. Do not make any modification to the base ignition map. The engine should start using the base map. In the dashboard screen RPM's will be shown only if the actual RPM's are above 600. To verify if the ECU is reading RPM's during cranking go to the Diagnostic Panel and check RPM signal during cranking.

Diagnostic Panel Button

After the engine starts calibration of the ignition timing need to be performed. Go to "Sensors and Calibration" menu under "Ignition Calibration" option. It's very important to perform this step correctly to make sure that the ECU is controlling the correct ignition timing.

When you enter “Ignition Calibration” option, the ECU will lock the ignition timing to 20°. Timing light will be used to read ignition timing marks in the damper. There are two different ways of using the timing light for this step: (1) zero advance or (2) using 20°.



Use a timing light at 0° of advance to read the actual ignition timing in the damper for Leading Rotor 1 and, if needed, adjust the degrees in the ECU until the damper reading mark match the 20° (see Figure 3) that ECU is controlling. If you want to verify the Trailing ignition timing it should read 10°BTDC (if using a rotary split timing of 10°) (see Figure 3).

If you’re using the timing light with 20° of advance, the Leading Rotor 1 will read in the TDC mark and the Trailing should read 10°ATDC using a rotary split timing of 10° as shown in Figure 4. See section 12.1.2 of the installation manual for more details. With the timing light, verify that all ignition coils are working properly.

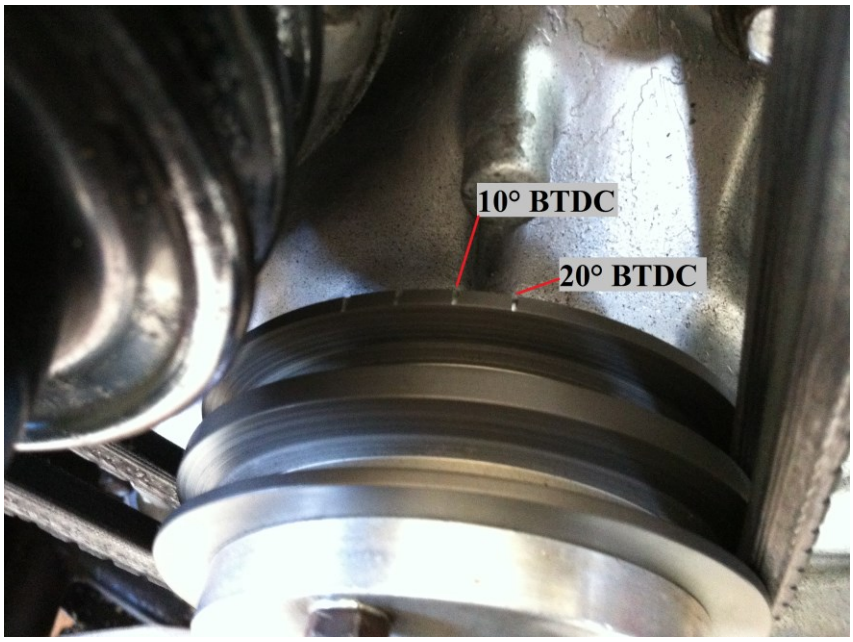


Figure 3 – 20° BTDC and 10° BTDC Ignition Timing Marks

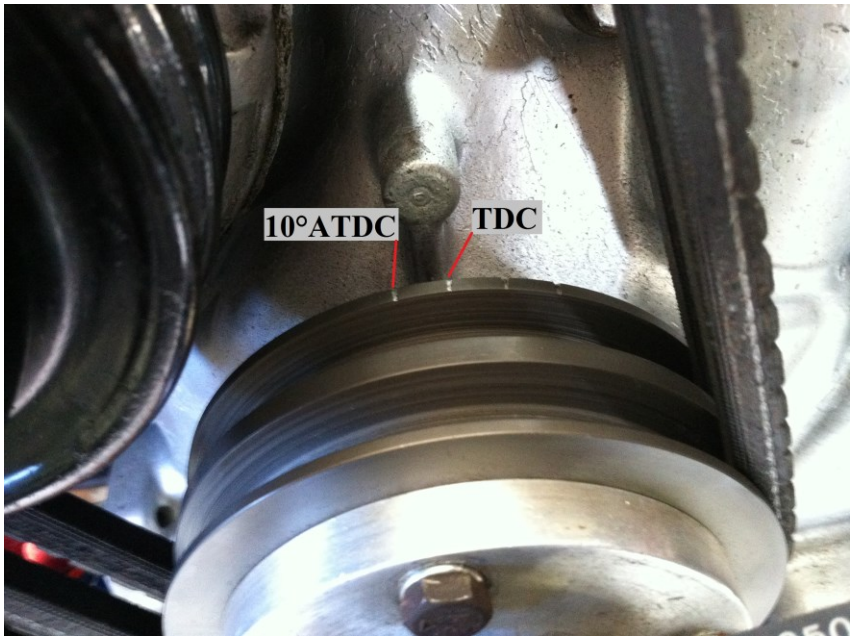


Figure 4 – TDC and 10°ATDC Ignition Timing Marks

After ignition timing calibration is performed your engine is ready for tuning. The base map should be a point to start tuning only. Be careful tuning your engine and never put load in the engine before it is properly tuned. Always start the tuning with a rich map and conservative ignition timing. A lean engine with an advanced timing will lead to serious engine damage. A rich engine with aggressive advanced timing could lead to serious engine damage also.