WOLF3D

Version 4.57

Engine Management System with
WIDEBAND AFR

Installation Manual

Revision Number 1.004

Printed May 31, 2004

CONTENTS

1 Introduction

This Installation Manual covers information on wiring, and fuel system plumbing.

The Wolf3D Version 4 is a totally new hardware and software platform with greatly expanded fuel and ignition maps with vastly improved resolution, as well as superior compensation tables and auxiliary functions.

The original DIP Switch configuration system used in older Wolf ECU's has been removed and replaced entirely with software based configuration menus that can be setup either with the Hand Controller, or the PC Software.

These expanded functions and expanded tunability are the result of requests, suggestions and feedback from customers over the past 8 years.

2 ECU

The Wolf3D Version 4 ECU is housed in an extremely robust aluminium extrusion. The Main connector is a waterproof connector with gold plated pins.

2.1 Mounting the ECU

There are many places to mount the Wolf3D Version 4 ECU.

- In the Glove Box
- On the kick panel in the foot well
- Under the dashboard
- On the floor on a raised platform (as long as the exhaust does not run near by)

Anywhere there is a dry, cool place is a good place to mount the ECU.

There are many places that we do not recommend you mount the Wolf3D Version 4 ECU.

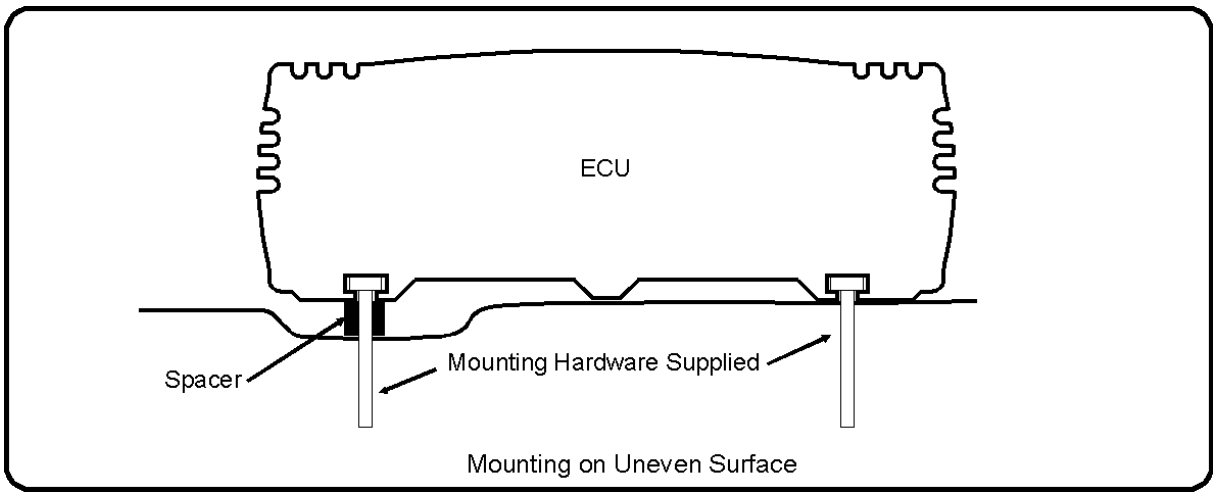
- On the transmission tunnel
- On the firewall
- On the floor if the exhaust system runs directly under the mounting position
- In the engine bay
- On the engine
- Where it will get wet

Anywhere there are extremes of heat and moisture are bad places to mount any ECU.

It is best to mount the ECU so you can easily view the Diagnostic LED's that can give you so much information while you are installing and configuring your ECU.

We recommend that after you have found the mounting place for your ECU, that you dismount it until you have the engine running, and are happy that the ECU is correctly configured. This will enable you to view the diagnostic LEDs while you are tuning your engine.

There are four mounting slides supplied with the ECU. These slides make mounting the ECU very easy.



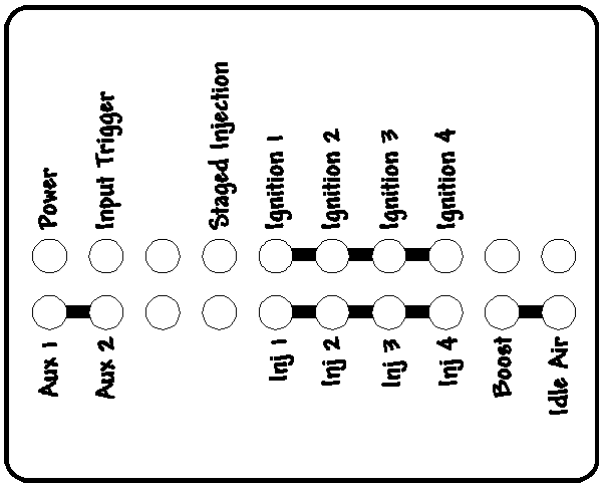
Mounting on Uneven Surface

You can mount the ECU on an uneven surface if you need to. Even the mounting holes do not have to be perfectly even, since the slides can be moved to suit the surface and distance between the mounting holes in the surface you are mounting the ECU to.

2.2 Diagnostic LED's

The ECU has a full complement of Diagnostic LED's at the end of the ECU between the Hand Controller connector and the Memory Cartridge/Communications connector.

These LED's allow you to see exactly what is going on with all of the inputs and outputs. You can "see" that the ECU is getting an Input Trigger, or that the Auxiliary Output that you are using is switching on and off, as you require.



There are bars between some of the LED's. These bars group together common functioning Outputs for easy reference.

Below is a table of the Diagnostic LED colours.

LED Colours	
Power	Green
Input Trigger	Red
Staged Injection	Yellow
Ignition 1	Red
Ignition 2	Red
Ignition 3	Red
Ignition 4	Red
Aux 1	Orange
Aux 2	Orange
Inj 1	Yellow
Inj 2	Yellow
Inj 3	Yellow
Inj 4	Yellow
Boost	Green
Idle Air	Green

3 Wiring

The most important aspect of installing an Engine Management System is to have the highest quality wiring installation that you possibly can.

Areas that can cause problems are:

- Bad wiring connections are the most common areas that cause problems during the installation and in the future.
- Using “Scotch Locks” to connect wires together. These clips can cause many problems in the future. They are not designed to be used for high quality wiring installations. Do not use these clips to install any wiring of your Wolf3D.
- Twisting wires together is a very unreliable way to join wires. Over time, the wires will oxidize, causing all types of signal problems in the future.
- Bad Earth and Bad +12V supply.
- Connecting +12V to the Starter Motor Solenoid. This is the very worst place to connect to for +12V. During cranking, the voltage is the very lowest at the Starter Motor.
- Battery at the other end of the vehicle. If you must mount the battery a long way away from the Starter Motor, make sure you run an earth wire the same size as the main power feed, from the battery to the engine block. Do not rely on the chassis as an earth return to the battery.

The best way to ensure your installation is accurate and reliable:

- Whenever you are joining wire, always use high quality wire of the same gauge as the wire you are joining to.
- Use the same colour wire when you extend wires to make future diagnosis quick and easy.
- Solder or crimp wires together using high quality solder or crimp terminals.
- Have high quality earth connections from the battery and the ECU to the engine block.
- Always run power to the ECU via a Fuse and a Relay from the battery.

3.1 Main Connector

The Main Connector used on the Wolf3D version 4 is a high quality 36 pin waterproof connector with gold plated pins. The wiring loom is supplied terminated at the ECU end. You can decide how you would like the installation of the wiring loom.

Do not wire any electrical components to the starter motor or starter motor solenoid. This can cause major problems with any electrical components during engine cranking.

3.1.1 Adding and Removing Terminals

Before adding or removing pins from the 36 pin connector, read this section. It will make the job run more smoothly.

Adding Terminals

- Disconnect the loom from the ECU.
- Remove the white anti-backout plate from the face of the loom connector.
- Place the silicon seal over the end of the wire to be inserted and push it back.
- Strip the end of the wire 4mm long.
- Place the terminal over the stripped end, while having the seal in the correct place for crimping it to the terminal.
- Crimp the smaller section first to the stripped section of wire. Make sure you use a good quality, crimping tool.
- Crimp the larger section of the terminal capturing the seal in place.

- Push the terminal and wire into the main connector.
- Replace the anti-backout plate.

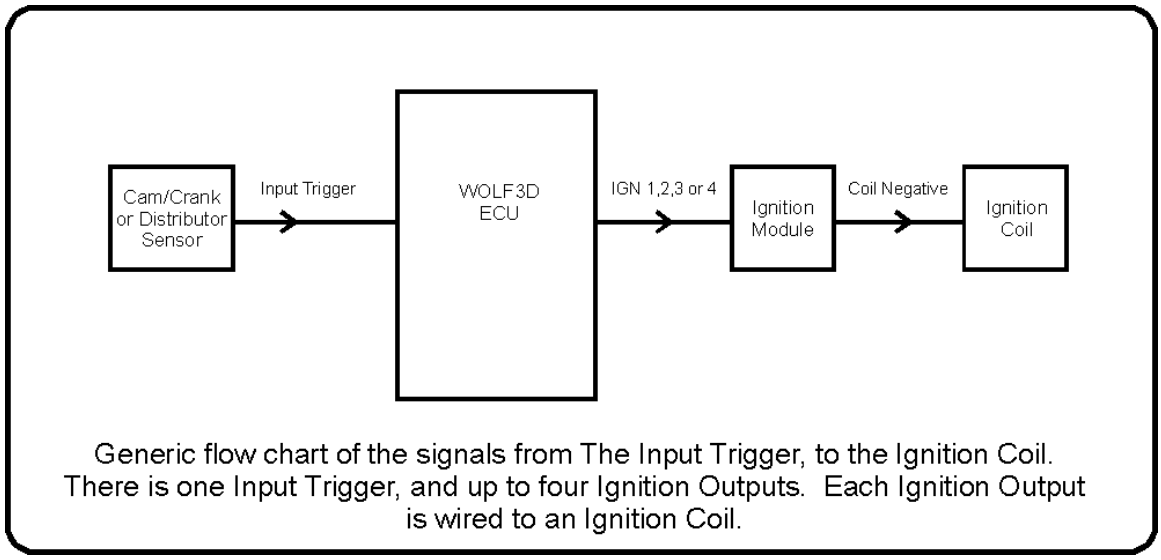
Do not use “Scotch Locks” for any wiring on this Engine Management System.

Removing Pins

- Disconnect the loom from the ECU.
- Remove the white anti-backout plate from the face of the loom connector.
- A plastic tab holds each pin in.
- You can see this tab by looking in the front side of the connector, it is just above the pin.
- Use a very small screwdriver to carefully lever up the plastic tab.
- While the tab is lifted, carefully pull out the wire from the back side of the connector.
- Replace the anti-backout connector.

3.2 Input Trigger

There is a standard way to wire in your Input Trigger and Ignition Output(s). Check out the diagram below for a basic flow chart of Input Triggers and Ignition Outputs.



Generic flow chart of the signals from The Input Trigger, to the Ignition Coil. There is one Input Trigger, and up to four Ignition Outputs. Each Ignition Output is wired to an Ignition Coil.

For best results, the input trigger must be setup at 60°BTDC. This is true whether your engine has a Crankshaft, Camshaft or Distributor Sensor.

Each time we refer to °BTDC we are referring to Crankshaft degrees.

Always reference everything to Crankshaft degrees.

The Wolf3D is best triggered as the input signal goes positive from 0V. This is called “Rising Edge” polarity.

There are two main types of Input Triggers:

- Crankshaft Trigger
- Camshaft/Distributor Trigger

Description	Pin Allocation	Wire Colour
Input Trigger (Sync)	6	Yellow
Input Trigger (Reference)	28	Brown/White
Input Trigger Ground	27	Blue/Green

These Input Triggers can be divided into three further groups:

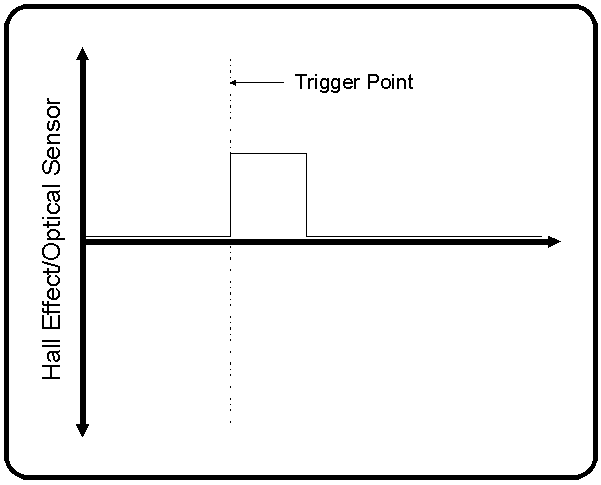
- **Single Pulse – Use Input Trigger Reference input only**
- **Dual Pulse – Use Input Trigger Reference input only**
- **Reference + Sync – Use both Input Triggers inputs Reference and Sync**

You will have to choose the type of Input Trigger based on the type of crank, distributor, or cam trigger you have on the engine. Or, you may wish to mount your own cam or crankshaft trigger and trigger disc, to make your installation more flexible.

3.2.1 Crankshaft Trigger

The Crankshaft Trigger can be either a dual or single pulse input trigger.

If you are using a Crankshaft Trigger, do not connect the Coil Negative Trigger to the ignition coil. You will not get a valid Crankshaft Trigger.



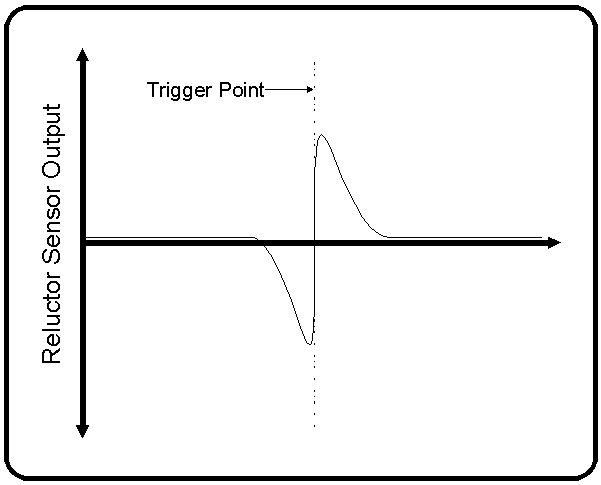
Both Reluctor (magnetic) and Hall Effect sensors can be used as a Crankshaft sensor. Refer to the User Guide for more information on configuration of the ECU.

When using a Hall Effect/Optical Crankshaft Trigger, the output of the sensor must look like this.

You must use a 1K Ohm, 1/4W pull-up resistor between the Trigger Signal wire and T+5 to +12V depending on the type of sensor being used.

When using a Reluctor Crankshaft Trigger, the output of the sensor must look like this.

The waveform goes negative first, crosses zero volts going positive, continues going positive, then returns to zero volts. The output of the Reluctor sensor must be like this. If the Reluctor sensor is wired the other way, the ignition timing will change incorrectly as the engine RPM changes.



Description	Pin Allocation	Wire Colour
Input Trigger	28	Brown/White
Input Trigger Ground	27	Blue/Green

3.2.2 Camshaft/Distributor Trigger

The Camshaft/Distributor Trigger can be either a dual or single pulse input trigger.

You must use a Camshaft Trigger when 4 cylinder sequential fuelling is required.

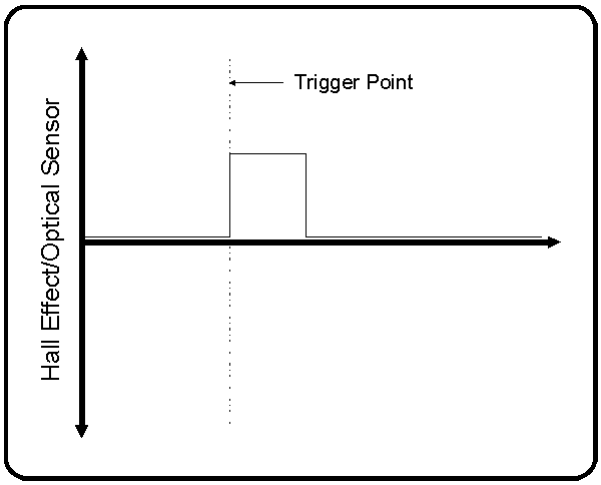
If you are using a Camshaft/Distributor Trigger, do not connect the Coil Negative Trigger to the ignition coil. If the Coil Negative is connected while using a Camshaft/Distributor Trigger, the Coil Negative input will override the Camshaft/Distributor Trigger.

Both Reluctor (magnetic), Hall Effect and Optical sensors can be used as a Crankshaft sensor. Refer to the User Guide for more information on configuration of the ECU.

You must use a 1K Ohm, 1/4W pull-up resistor between the Trigger Signal wire either +5V or +12V, depending on the type of sensor being used.

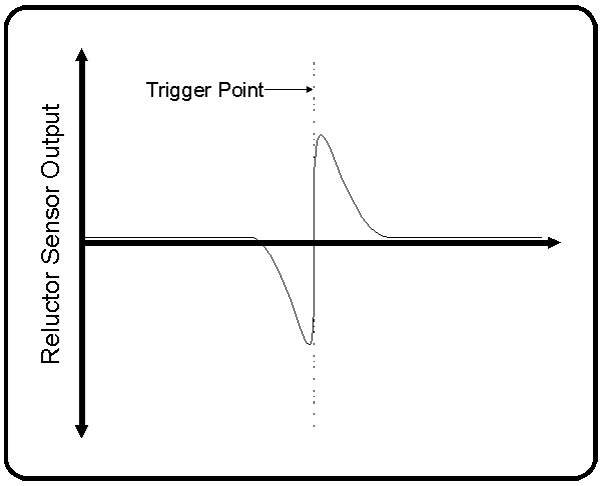
Make sure you determine the correct supply voltage for the exact sensor type you are using. If you use +12V, and the sensor is designed for +5V operation, you can damage the sensor. If the sensor is designed for +12V operation, and you supply +5V, the operation of the sensor may be altered or intermittent.

When using a Hall Effect/Optical Crankshaft Trigger, the output of the sensor must look like this.



When using a Reluctor Crankshaft Trigger, the output of the sensor must look like this.

The waveform goes negative first, crosses zero volts going positive, continues going positive, then returns to zero volts. The output of the Reluctor sensor must be like this. If the Reluctor sensor is wired the other way, the ignition timing will change incorrectly as the engine RPM changes.

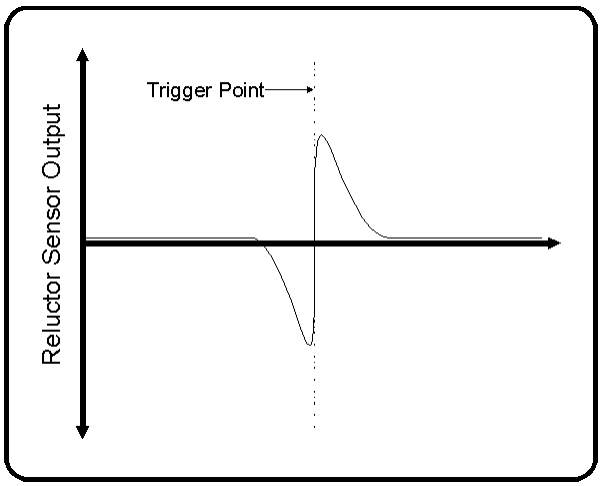


Description	Pin Allocation	Wire Colour
Input Trigger	28	Brown/White
Input Trigger Ground	27	Blue/Green

There are two types of Sensors that can be used for Input Triggering

- **Reluctor (magnetic)**
- **Hall Effect/Optical**

Reluctor (magnetic) sensors do not require any power to operate. The magnet surrounded by a coil of wire produces the entire voltage output. When a ferrous metal passes through the magnetic flux at the end of the sensor, a voltage is induced into the coil of wire surrounding the magnet. We use this voltage output to trigger the ECU.



The output of a Reluctor sensor is a sine wave. Notice that the waveform goes negative first, crosses zero volts going positive, continues going positive, then returns to zero volts. The output of the Reluctor sensor must be like this. If the Reluctor sensor is wired the other way, the ignition timing will change incorrectly as the engine RPM changes.

There are several aspects to consider when using a Reluctor sensor that must be taken into account.

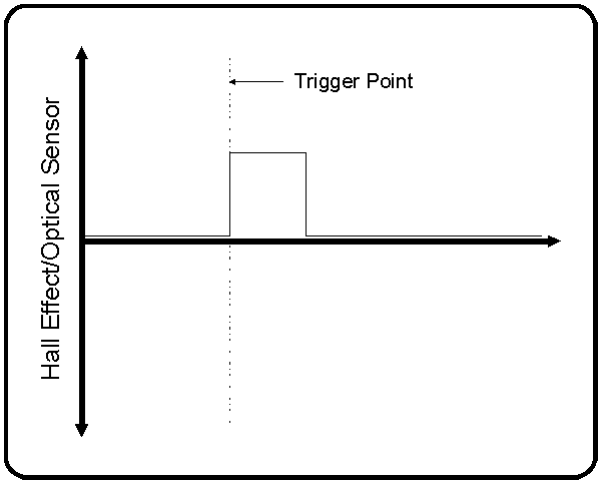
- Each of the teeth must be accurately measured to ensure that the angular dimensions are correct and even.
- Each tooth must have precisely the same gap from the sensor tip to the top of the tooth. When you are making your disc, you must true up the tops of all of the teeth. Many people true up the teeth by putting the disc into lathe and machine the tops of the teeth off until they are all at the same height.
- The leading and trailing edges of each tooth must be sharp.
- There must be no other ferrous items rotating near the sensor that are not meant to trigger the ECU. These items might cause Signal Errors at high engine RPM's.
- If you use metals that are low in Iron, the change in the Reluctor's magnetic flux will be reduced, and will require the engine to rotate faster to produce the same output voltage. Mild Steel is the best metal to use for camshaft or crankshaft teeth when using a Reluctor sensor.

You cannot use a voltmeter to measure the output from a Reluctor sensor; you must view the waveform using an oscilloscope.

Description	Pin Allocation	Wire Colour
Input Trigger Reference	28	Brown/White
Input Trigger Ground	27	Blue/Green

Hall Effect/Optical sensors require voltage to power the device.

The output of the Hall Effect/Optical sensor is a square wave. The ECU triggers off the rising edge of the square wave output of the Hall Effect/Optical sensor. The supply voltage used to power the sensor is usually between +5V and +12V. Many sensors can use either voltage. Check with the sensor manufacturer for supply voltage recommendations.



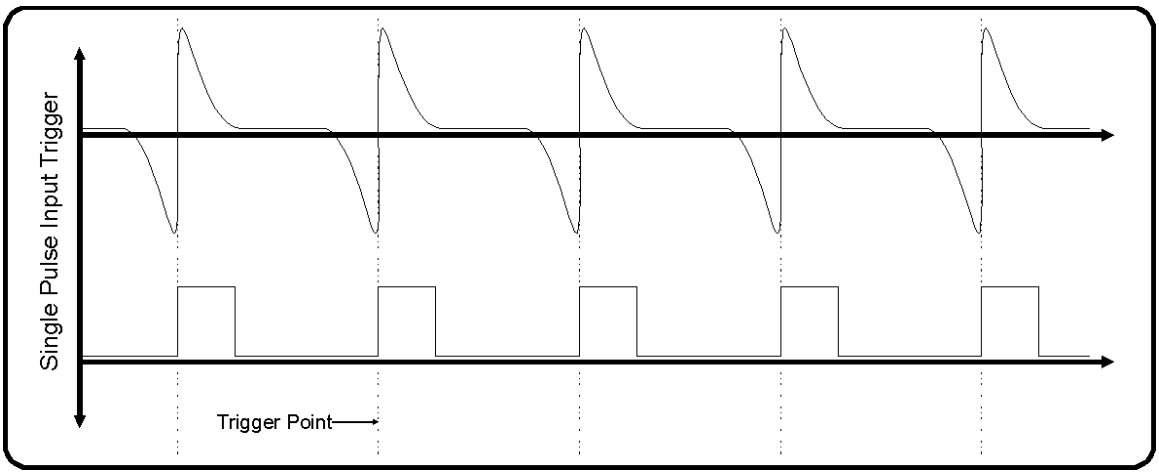
There are several aspects to consider when using a Hall Effect/Optical sensor that must be taken into account. Determine if the signal goes low to high when the ferrous metal or the air gap passes the sensor. Each rising edge must be must be extremely accurately measured to ensure that the angular dimensions are correct and even.

Hall Effect sensors generally do not output a voltage. They pull the signal wire to ground. To achieve a +5V square wave, there must be a pull-up resistor between the Hall Effect signal wire, and +5V.

Description	Pin Allocation	Wire Colour
Input Trigger Reference	28	Brown/White
Input Trigger Ground	27	Blue/Green

3.2.3 Single Pulse Input Triggering

Single Pulse describes Input Trigger pulses that are evenly spaced without a crankshaft or Camshaft/Distributor position reference pulse. All of the pulses have the same angular spacing. Single Pulse Input Triggering does not have a reference for Cylinder number 1 TDC, hence you cannot use Single Pulse Input Triggering for multi-coil applications.



Above are examples of both Reluctor and Hall Effect/Optical sensor Single Pulse outputs.

Examples of Single Pulse Input Triggers are:

- Coil Negative
- Many Distributor Sensors
- Some Camshaft Sensors
- Some Crankshaft Sensors

Description	Pin Allocation	Wire Colour
Input Trigger Reference	28	Brown/White
Input Trigger Ground	27	Blue/Green

3.2.3.1 Rotary Single Pulse Input Triggering

You can use Single Pulse Input Triggering for single and 2 Rotor rotary engines. The ECU takes the single input trigger pulse, and outputs leading and trailing ignition pulses. There pulses are directed to the correct sparkplugs via the distributor.

You must use a distributor when running a 2 Rotor rotary engine with Single Pulse Input Triggering.

3 Rotor engines generally do not have distributors, so Single Pulse Input Triggering is not appropriate for these engines.

3.2.3.2 1 Cylinder Single Pulse Input Triggering

There must be either 1 trigger point per crankshaft rotation, or camshaft rotation. A single cylinder engine has no distributor, since each spark event is directed to the same sparkplug.

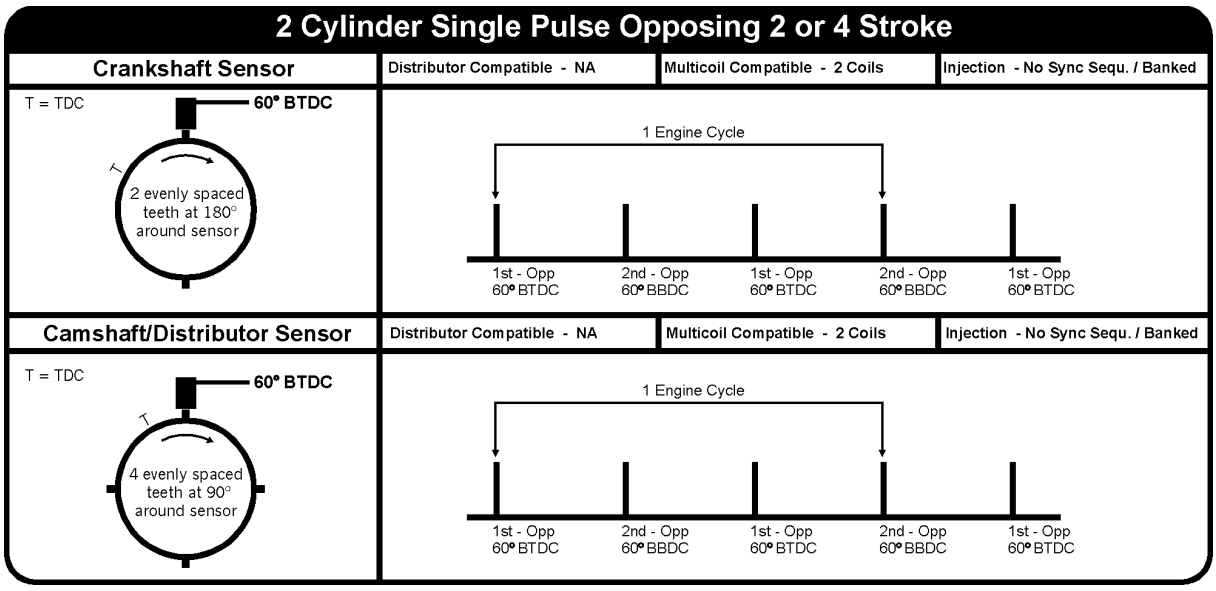
2-Stroke Engine – Each time the piston comes to the top of the cylinder, there is a spark event. Since there is no camshaft on a 2-Stroke engine, you must use the crankshaft with 1 trigger point per revolution.

4-Stroke Engine – Each second time the piston comes to the top of the cylinder, there is a spark event. You can mount a sensor on either the crankshaft, or the camshaft. If you mount the sensor on the crankshaft there will be a wasted spark event, which means that there will be a spark when the engine is on its exhaust stroke, as well as when it is on its compression stroke. This is not a problem in almost all applications. If you decide to the use a cam sensor, there will be no wasted spark event, that is, there will only ever be a spark event when the engine is on its compression stroke.

3.2.3.3 2 Cylinder Single Pulse Input Triggering

2 Cylinder engines are divided into two classes:

Opposed cylinders – have the pistons moving up and down in the opposite direction to each other.

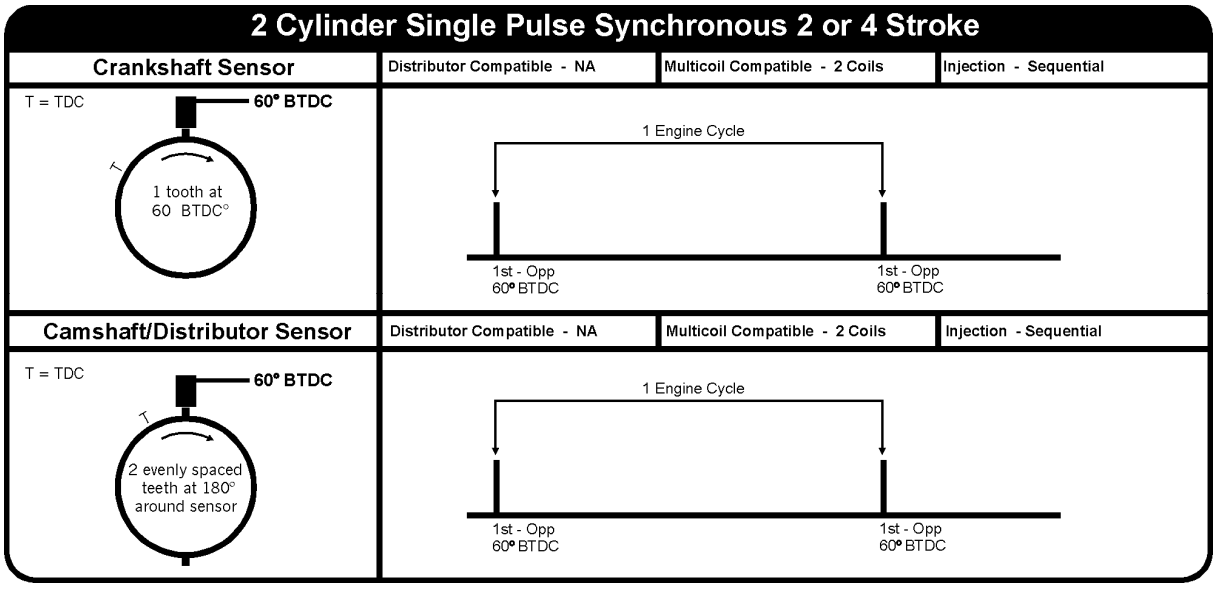


2-Stroke Engine – Each time one of the pistons comes to the top of the cylinder, there is a spark event. Since there is no camshaft on a 2-Stroke engine, you must use the crankshaft with 2 trigger points per revolution, one for each piston.

4-Stroke Engine – Each second time the piston comes to the top of the cylinder, there is a spark event. You can mount a sensor on either the crankshaft, or the camshaft. If you mount the sensor on the crankshaft there will be a wasted spark event, which means that there will be a spark when the engine is on its exhaust stroke, as well as when it is on its compression stroke. This is not a problem in almost all applications. If you decide to the use a cam sensor, there will be no wasted spark event, that is, there will only ever be a spark event when the engine is on its compression stroke.

There must be 2 trigger points per crankshaft rotation. If you are using a camshaft as the input trigger device, there must be 4 trigger points per camshaft rotation.

Synchronous cylinders – have the two pistons moving up and down the cylinders together, in the same direction.

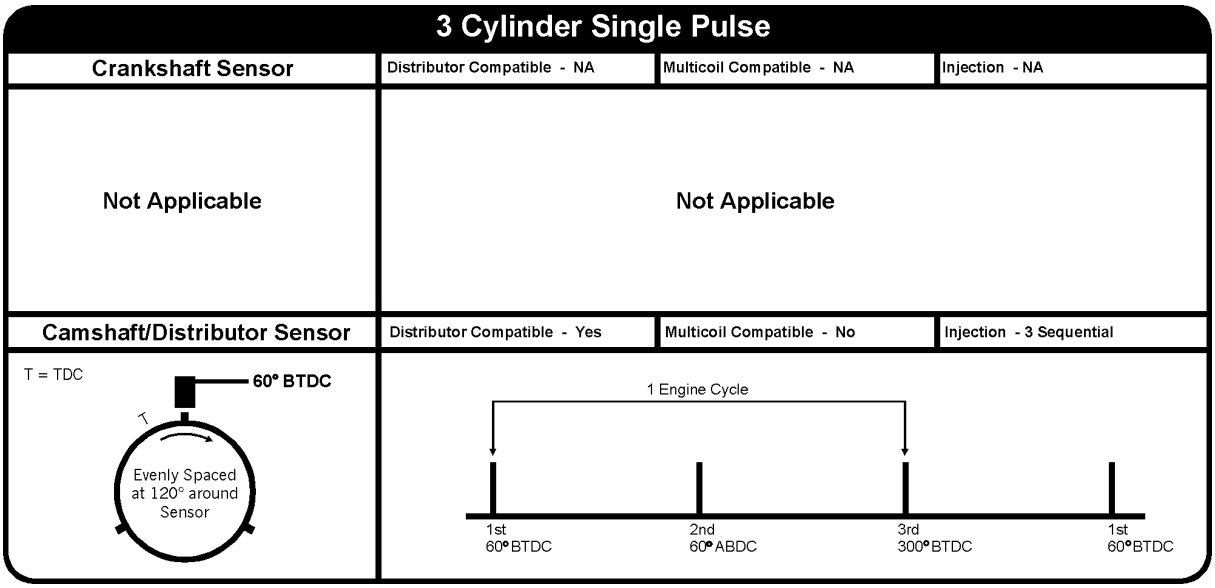


2-Stroke Engine – Each time the piston comes to the top of the cylinder, there is a spark event. Since there is no camshaft on a 2-Stroke engine, you must use the crankshaft with 1 trigger point per revolution.

4-Stroke Engine – Each second time the piston comes to the top of the cylinder, there is a spark event. You can mount a sensor on either the crankshaft, or the camshaft. If you mount the sensor on the crankshaft there will be a wasted spark event, which means that there will be a spark when the engine is on its exhaust stroke, as well as when it is on its compression stroke. This is not a problem in almost all applications. If you decide to the use a cam sensor, there will be no wasted spark event, that is, there will only ever be a spark event when the engine is on its compression stroke.

There must be 1 trigger point per crankshaft rotation. If you are using a camshaft as the input trigger device, there must be 2 trigger points per camshaft rotation.

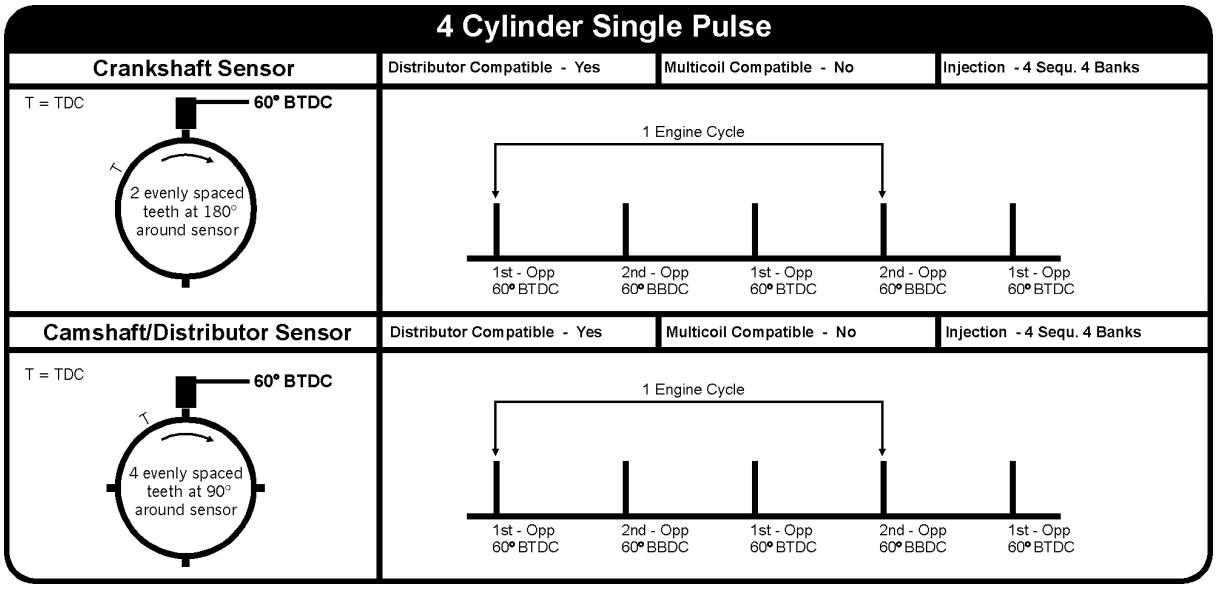
3.2.3.4 3 Cylinder Single Pulse Input Triggering



When using a Single Pulse Input Trigger on a 3 Cylinder Engine you cannot use a crankshaft trigger, you must use a camshaft/distributor trigger. A 3 cylinder engine must have 3 trigger points per camshaft/distributor rotation.

You must use a distributor when running a 3 Cylinder Engine with Single Pulse Input Triggering.

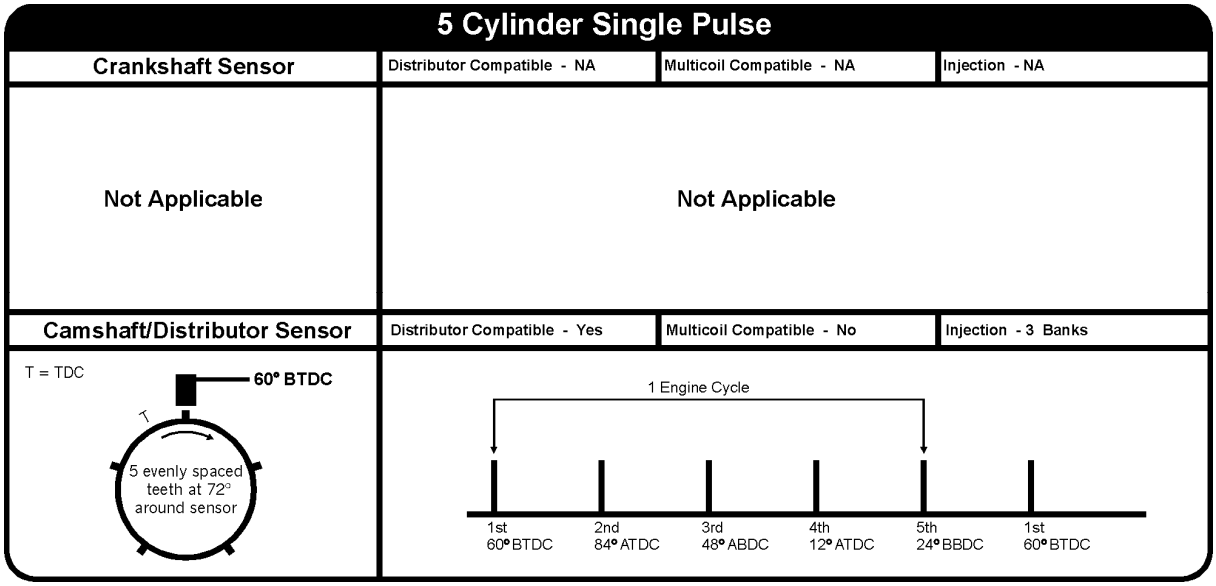
3.2.3.5 4 Cylinder Single Pulse Input Triggering



There must be 2 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 4 trigger points per camshaft rotation.

You must use a distributor when running a 4 Cylinder Engine with Single Pulse Input Triggering.

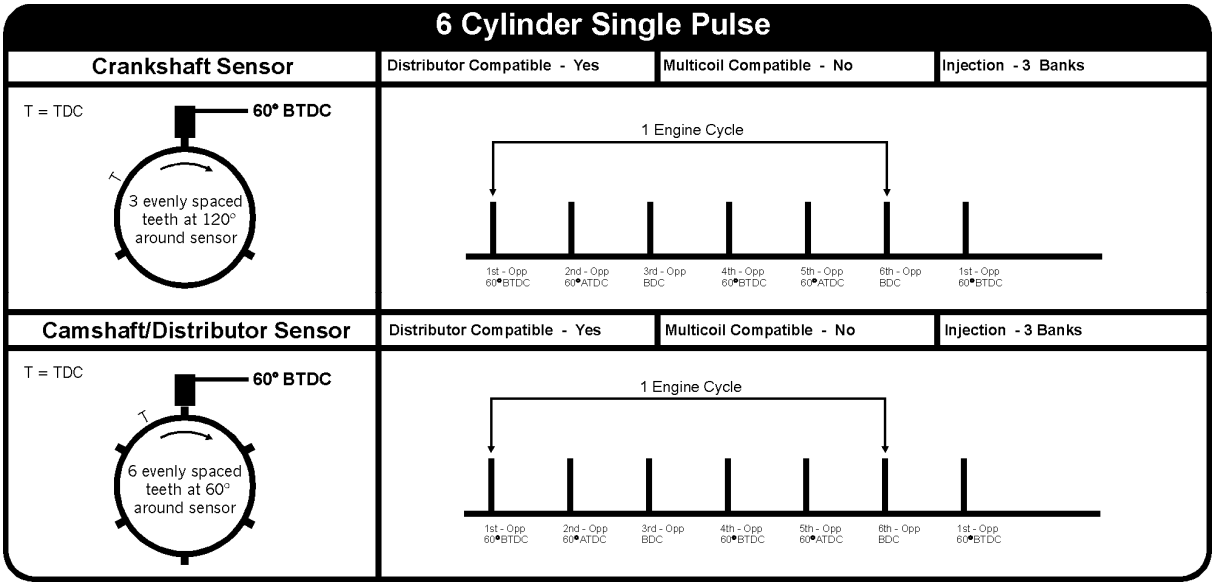
3.2.3.6 5 Cylinder Single Pulse Input Triggering



On a 5 Cylinder Engine you cannot use a crankshaft trigger, you must use a camshaft/distributor trigger. If you are using a distributor as the input trigger device, there must be 5 trigger points per camshaft/distributor rotation.

You must use a distributor when running a 5 Cylinder Engine with Single Pulse Input Triggering.

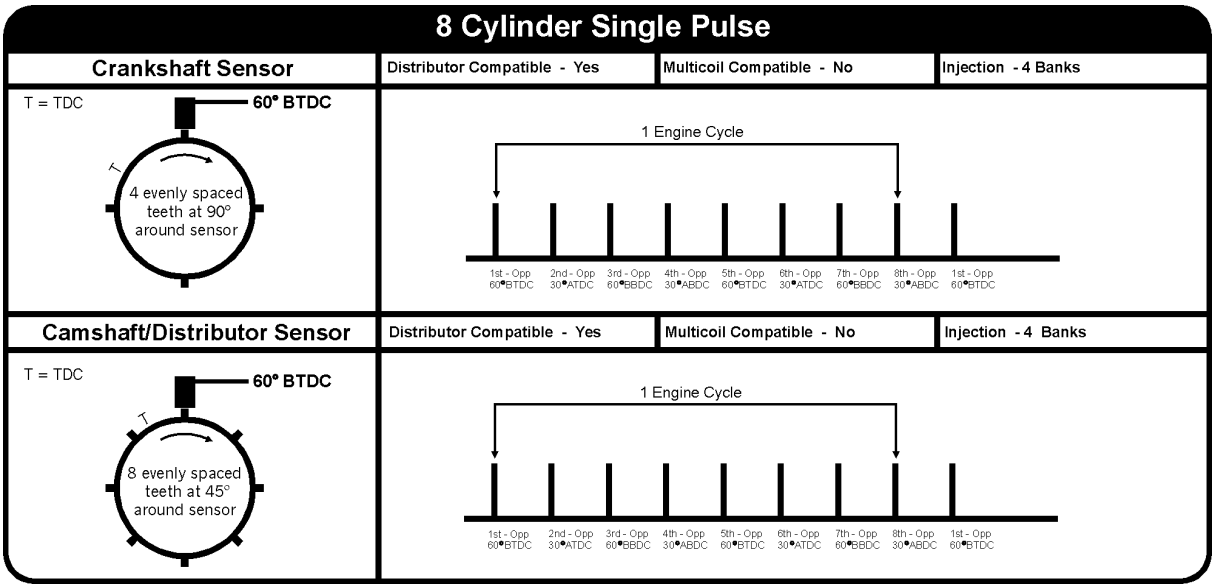
3.2.3.7 6 Cylinder Single Pulse Input Triggering



There must be 3 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 6 trigger points per camshaft/distributor rotation.

You must use a distributor when running a 6 Cylinder Engine with Single Pulse Input Triggering.

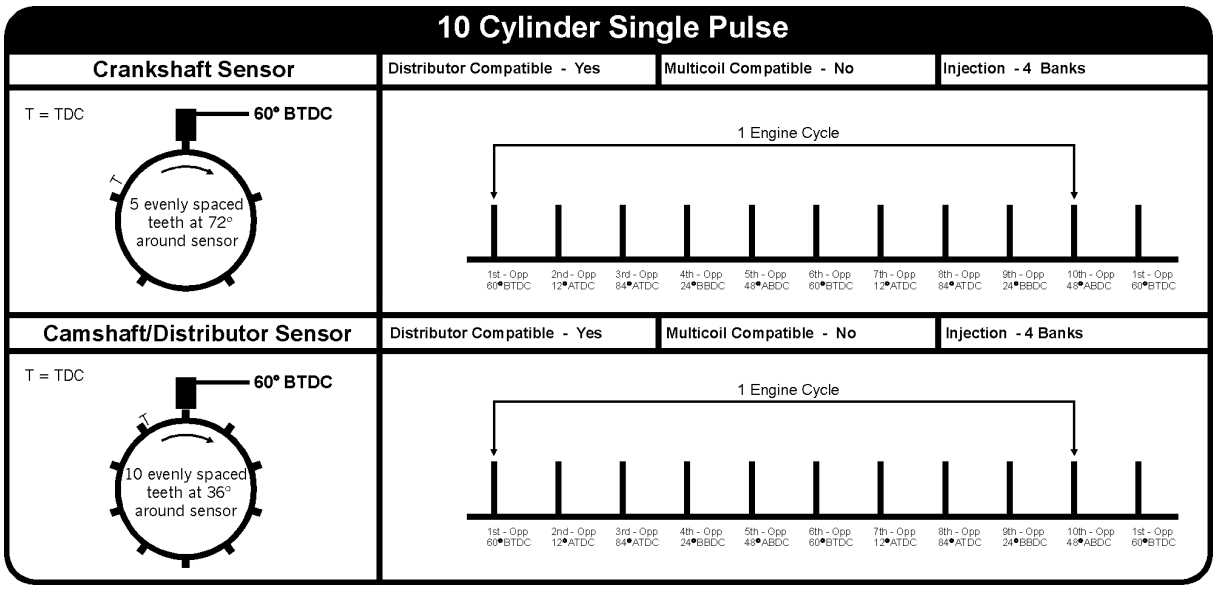
3.2.3.8 8 Cylinder Single Pulse Input Triggering



There must be 4 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 8 trigger points per camshaft/distributor rotation.

You must use a single distributor when running an 8 Cylinder Engine with Single Pulse Input Triggering.

3.2.3.9 10 Cylinder Single Pulse Input Triggering

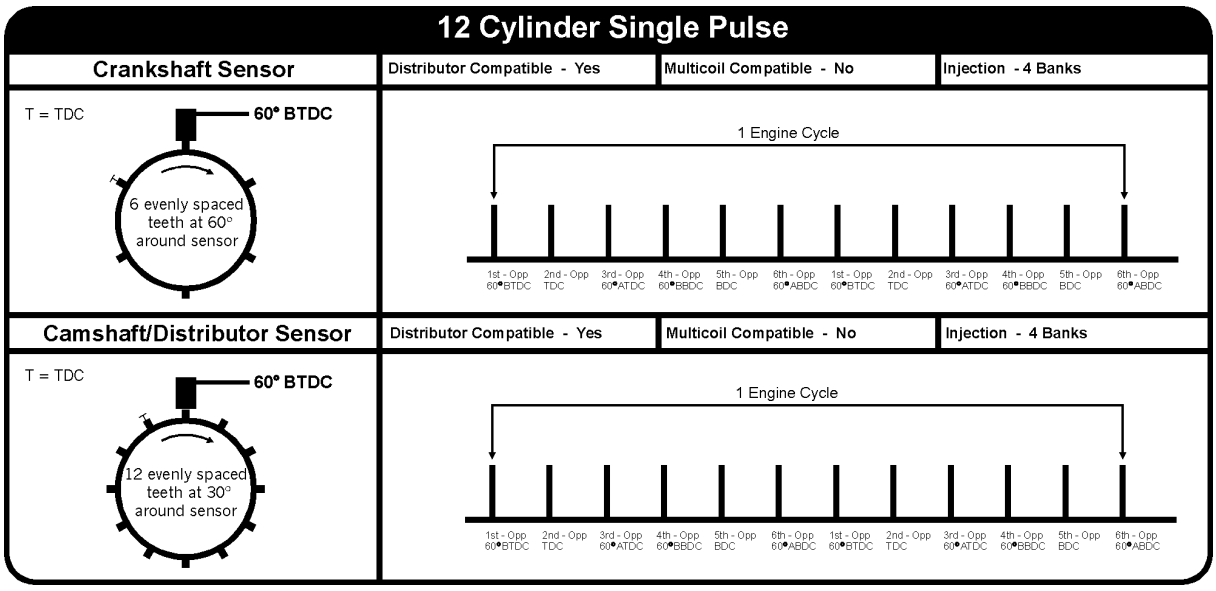


The Wolf3D Version 4 supports Single Pulse Input Triggering.

There must be 5 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 10 trigger points per camshaft /distributor rotation.

You must use a single distributor when running a 10 Cylinder Engine with Single Pulse Input Triggering.

3.2.3.10 12 Cylinder Single Pulse Input Triggering

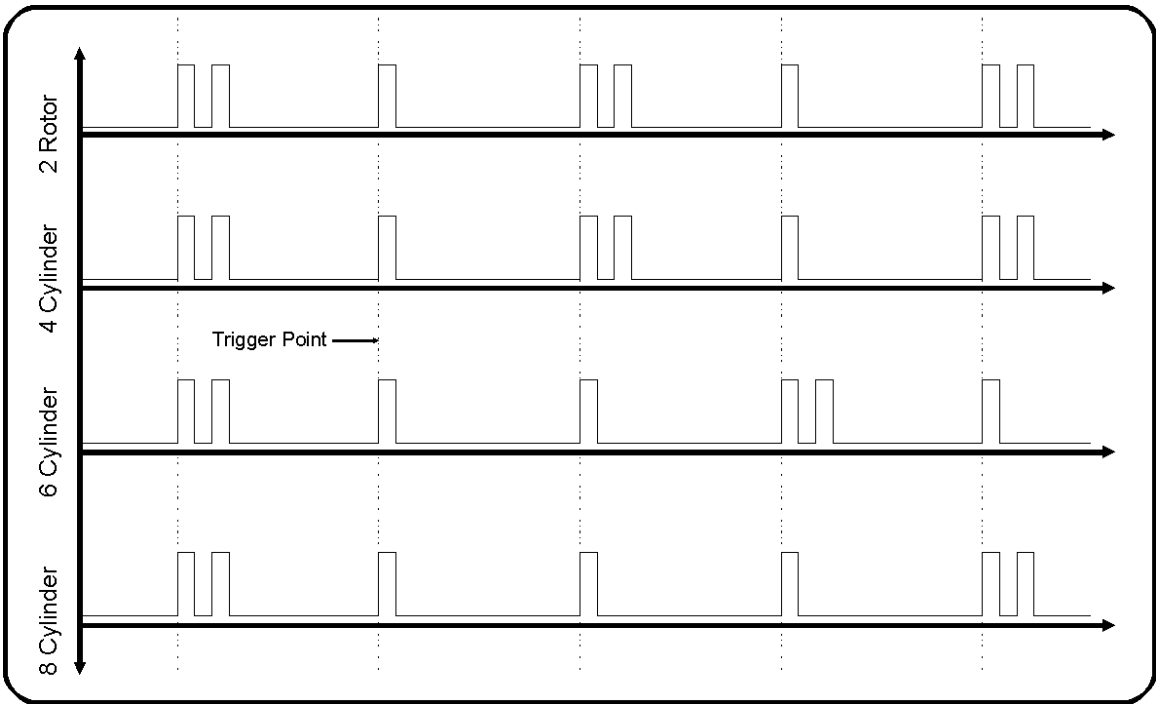


The Wolf3D Version 4 supports Single Pulse Input Triggering.

There must be 6 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 12 trigger points per camshaft /distributor rotation.

You must use a single distributor when running a 12 Cylinder Engine with Single Pulse Input Triggering.

3.2.4 Dual Pulse Input Triggering



Dual Pulse describes Input Trigger pulses that have a reference for Cylinder number 1 from the crankshaft or camshaft position. If you are going to use a multi-coil ignition system, you must use a Dual Pulse Input Trigger system. This allows the ECU to determine when cylinder (Rotor) number 1 is at Top Dead Center (TDC).

Above is an example graph of some different Dual Pulse Input Trigger pulse trains from a Hall Effect/Optical sensor. Each leading edge of the first of the Dual Pulse teeth, and the leading edge of any other teeth are the trigger point for each cylinder that it corresponds to.

3.2.4.1 Rotary Dual Pulse Input Triggering

You can use Dual Pulse Input Triggering for single and 2 Rotor rotary engines.

You must use a distributor when running a 2 Rotor rotary engine with Single Pulse Input Triggering.

3 Rotor engines generally do not have distributors, so Single Pulse Input Triggering is not appropriate for these engines.

3.2.4.2 1 Cylinder Dual Pulse Input Triggering

Since there is only one sparkplug on a single cylinder engine, you do not have to use Dual Pulse Input Triggering.

3.2.4.3 2 Cylinder Dual Pulse Input Triggering

2 Cylinder engines are divided into two classes:

Opposed cylinders – have the pistons moving up and down in the opposite direction to each other.

2-Stroke Engine – Each time one of the pistons comes to the top of the cylinder, there is a spark event. For Dual Pulse Triggering you must use the crankshaft with 2 trigger points per revolution, one for each piston.

4-Stroke Engine – Each second time the piston comes to the top of the cylinder, there is a spark event. You can mount a sensor on either the crankshaft, or the camshaft. If you mount the sensor on the crankshaft there will be a wasted spark event, which means that there will be a spark when the engine is on its exhaust stroke, as well as when it is on its compression stroke. This is not a problem in almost all applications. If you decide to the use a cam sensor, there will be no wasted spark event, that is, there will only ever be a spark event when the engine is on its compression stroke.

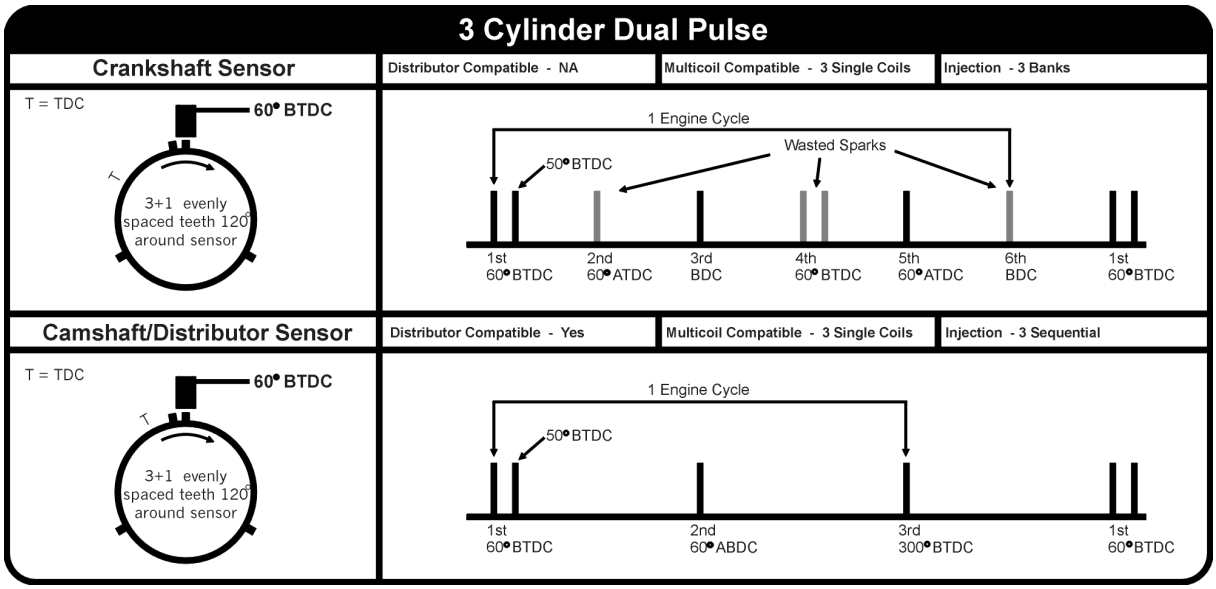
There must be 2 trigger points per crankshaft rotation. If you are using a camshaft as the input trigger device, there must be 4 trigger points per camshaft rotation.

Synchronous cylinders – have the two pistons moving up and down the cylinders together, in the same direction.

2-Stroke Engine – Each time the piston comes to the top of the cylinder, there is a spark event. There is no benefit from using Dual Pulse Input Triggering on this type of engine.

4-Stroke Engine – Each second time the piston comes to the top of the cylinder, there is a spark event. You can mount a sensor on either the crankshaft, or the camshaft. If you mount the sensor on the crankshaft there will be a wasted spark event, which means that there will be a spark when the engine is on its exhaust stroke, as well as when it is on its compression stroke. This is not a problem in almost all applications. If you decide to the use a cam sensor, there will be no wasted spark event, that is, there will only ever be a spark event when the engine is on its compression stroke.

3.2.4.4 3 Cylinder Dual Pulse Input Triggering

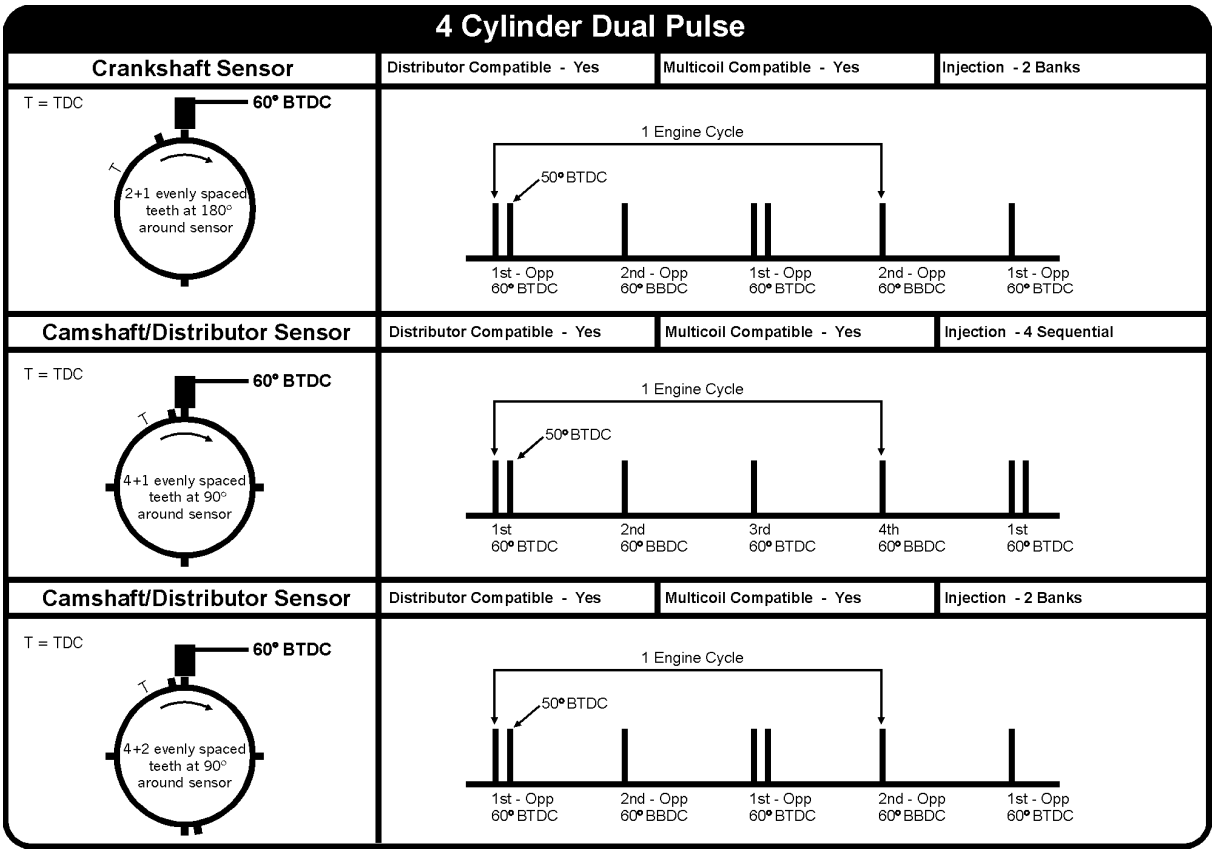


There must be 3+1 trigger points per crankshaft rotation. Because of the unique nature of 3 cylinder engines, if you are using a crankshaft sensor, you must run 3 single ignition coils. The coils will be fired in a wasted spark format. This will not cause any problems for the majority of installations. Wasted spark ignition is used successfully on many OEM installations.

A 3 cylinder engine must have 3+1 trigger points per camshaft/distributor rotation.

To run multicoil ignition, you must use Dual Pulse Input Triggering on a 3 Cylinder engine.

3.2.4.5 4 Cylinder Dual Pulse Input Triggering

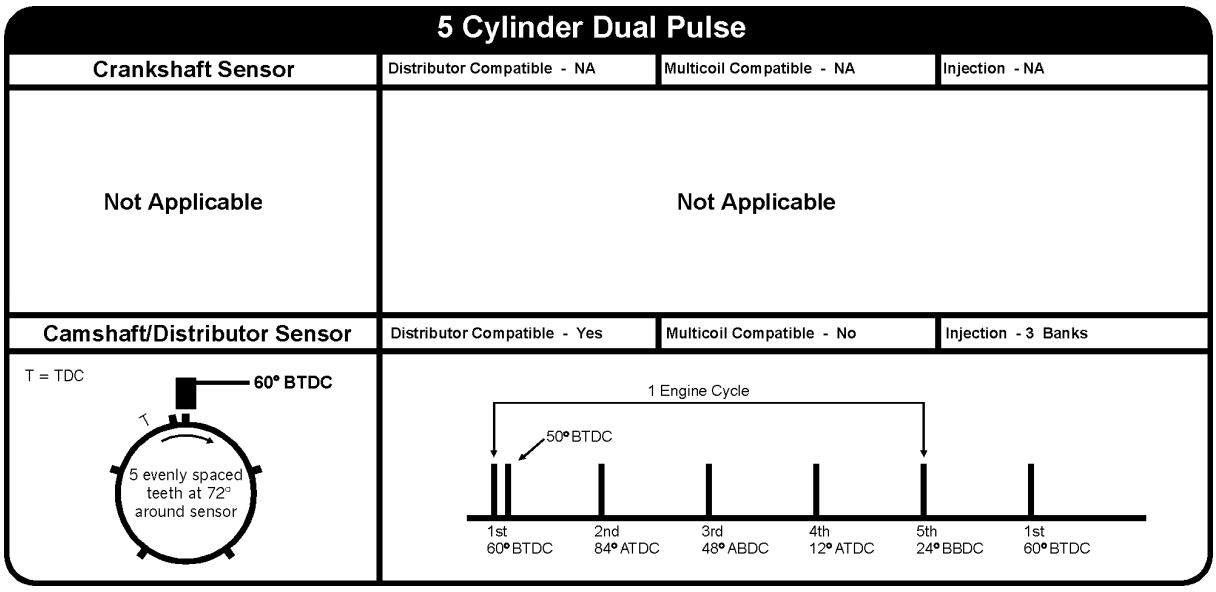


There must be 2 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 4 trigger points per camshaft rotation.

You can use a distributor when running a 4 Cylinder Engine with Dual Pulse Input Triggering.

To run multicoil ignition, you must use Dual Pulse Input Triggering on a 4 Cylinder engine.

3.2.4.6 5 Cylinder Dual Pulse Input Triggering

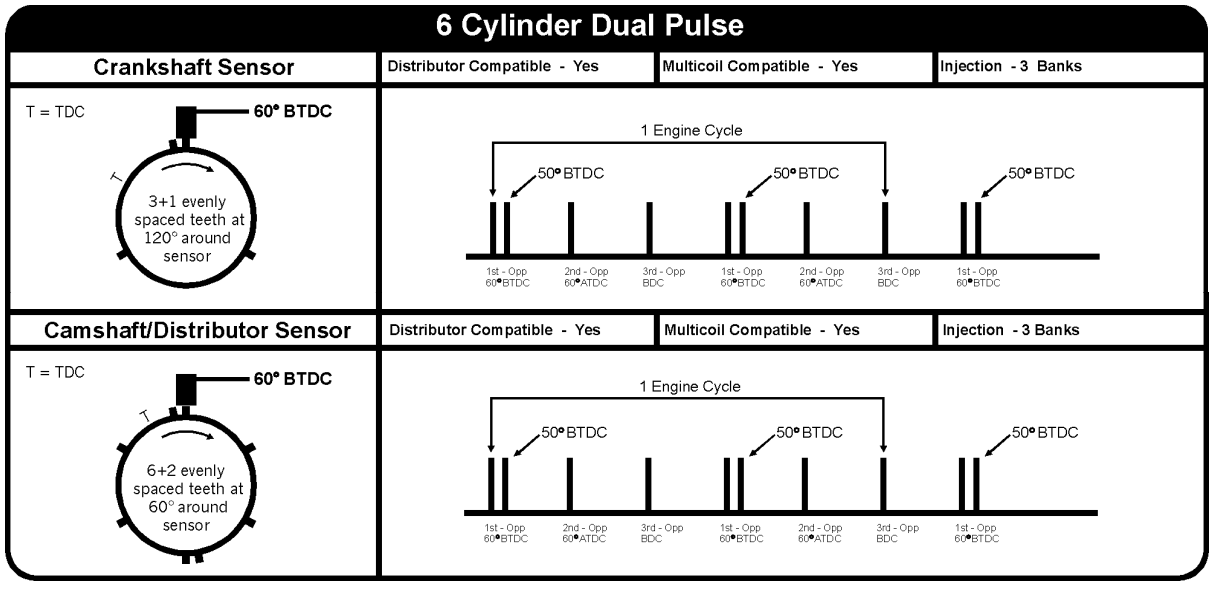


On a 5 Cylinder Engine you cannot use a crankshaft trigger, you must use a camshaft/distributor trigger. If you are using a distributor as the input trigger device, there must be 5 trigger points per camshaft/distributor rotation.

You can use a distributor when running a 5 Cylinder Engine with Dual Pulse Input Triggering.

You cannot run a 5 Cylinder Engine in multicoil mode using a Wolf3D Version 4.

3.2.4.7 6 Cylinder Dual Pulse Input Triggering

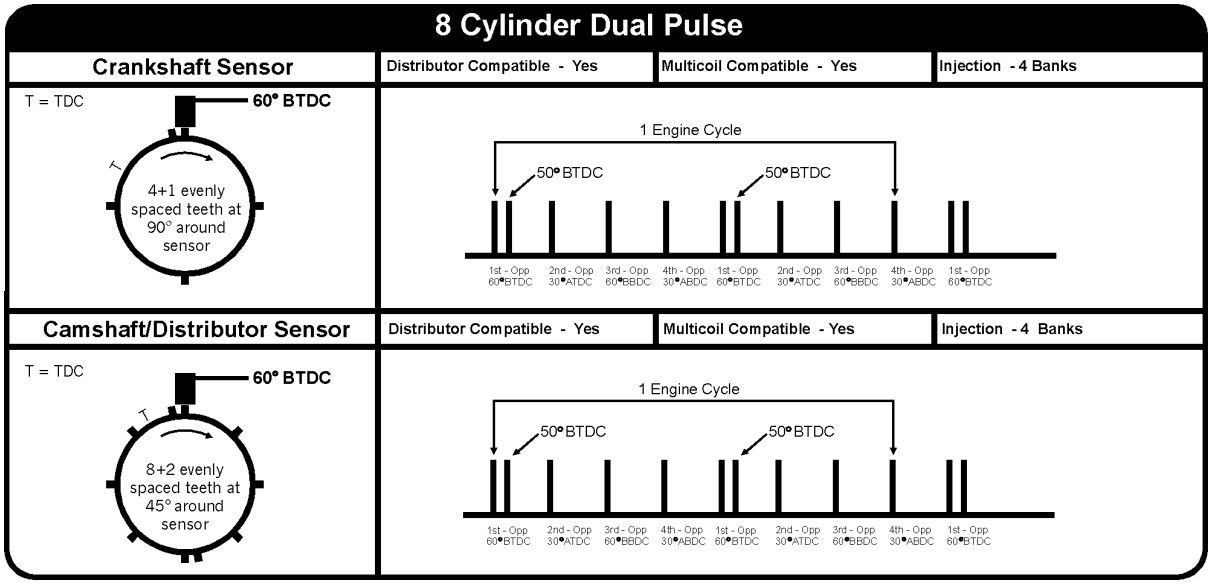


There must be 3 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 6 trigger points per camshaft/distributor rotation.

You can use a distributor when running a 6 Cylinder Engine with Dual Pulse Input Triggering.

To run multicoil ignition, you must use Dual Pulse Input Triggering on a 6 Cylinder engine.

3.2.4.8 8 Cylinder Dual Pulse Input Triggering

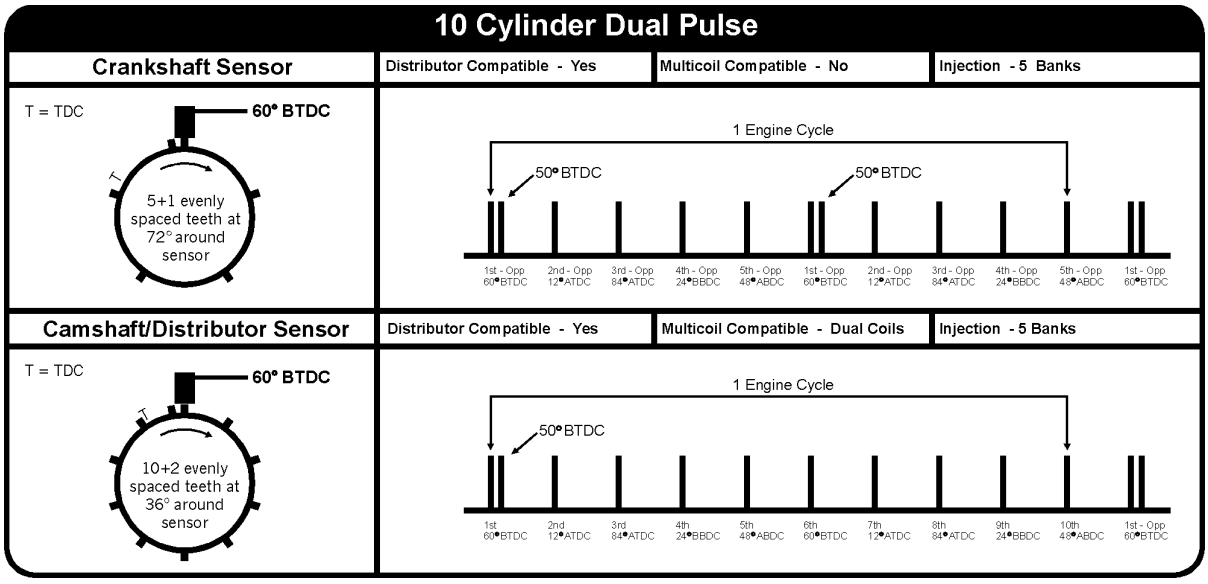


There must be 4 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 8 trigger points per camshaft/distributor rotation.

You can use either a single distributor with 8 ignition wires, or 2 distributors with 4 ignition wires each when running a 8 Cylinder Engine with Dual Pulse Input Triggering.

To run multicoil ignition, you must use Dual Pulse Input Triggering on an 8 Cylinder engine.

3.2.4.9 10 Cylinder Dual Pulse Input Triggering



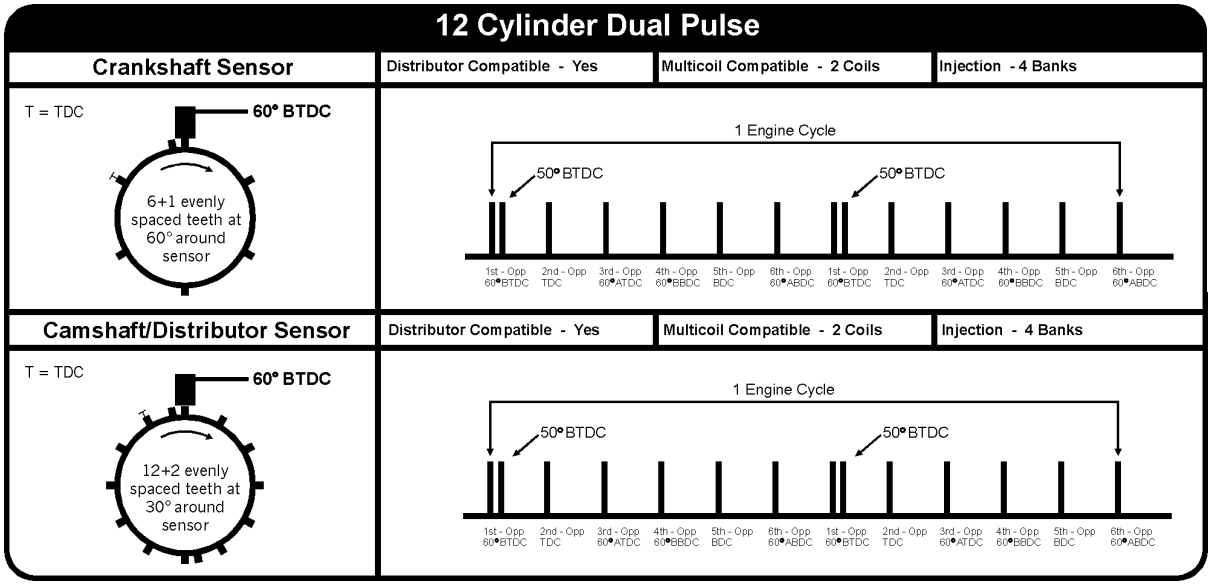
The Wolf3D Version 4 supports Dual Pulse Input Triggering for 10 Cylinder Engines.

There must be 5 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 10 trigger points per camshaft /distributor rotation.

You can use either a single distributor with 10 ignition wires, or 2 distributors with 5 ignition wires each when running a 10 Cylinder Engine with Dual Pulse Input Triggering.

You cannot run a 10 Cylinder Engine in multicoil mode, only Dual Coil mode using a Wolf3D Version 4.

3.2.4.10 12 Cylinder Dual Pulse Input Triggering



The Wolf3D Version 4 supports Dual Pulse Input Triggering.

There must be 6 trigger points per crankshaft rotation. If you are using a distributor as the input trigger device, there must be 12 trigger points per camshaft /distributor rotation.

You can use a single distributor with 12 ignition wires, or 2 distributors with 6 ignition wires each when running a 12 Cylinder Engine with Dual Pulse Input Triggering.

To run Duel Coil ignition, you must use Dual Pulse Input Triggering on a 12 Cylinder engine.

Examples of Dual Pulse Input Triggers are:

- Some Distributor Sensors
- Many Camshaft Sensors
- Many Crankshaft Sensors

Description	Pin Allocation	Wire Colour
Input Trigger Reference	28	Brown/White
Input Trigger Ground	27	Blue/Green

3.2.5 Reference and Sync Triggering

Many common Cam and Crankshaft Triggering systems used on engines today use Reference and Sync signal system. This usually consists of some number of evenly spaced teeth on the crank, or cam (usually 8 or 12 per crank revolution), and 1 or 2 teeth on the camshaft or crankshaft.

The Wolf3D V4 sees the first reference pulse after the Sync pulse as the Dual Pulse (60 BTDC). We call these teeth Ghost Teeth. The Wolf then counts around the crankshaft, and chooses another tooth to be used as a single ghost tooth. The ECU can continue to do this until there are the correct number of ghost teeth for the engine type you are using.

Below are some examples of how to set up Reference and Sync on various engine types.

Currently Reference and Sync Mode can only be configured via the PC software. Refer to User Guide 1.015 or later for information on configuring Reference and Sync Mode.

3.3 Inputs - Sensors

Sensors on the engine allow the Wolf3D to know what the engine is doing, and determine how much fuel and what ignition timing the engine needs.

The sensors that the Wolf3D Version 4 uses are:

- Crankshaft/Camshaft Position
- Air Temperature
- Water Temperature
- MAP/MAF
- Throttle Position
- Battery Voltage
- Oxygen Sensor
- Aircon Request/ Switch

RPM, Crankshaft and Camshaft sensors are covered in previous chapters.

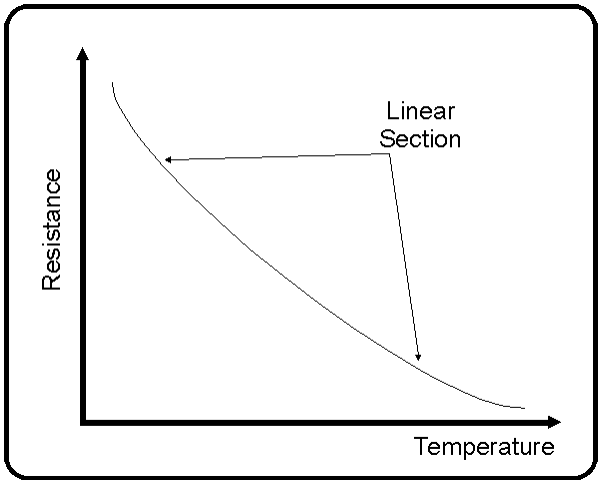
3.3.1 Temperature Sensors

The Wolf3D Version 4 can use many different Temperature Sensors, for Water and Air Temperature Sensing.

The majority of Air Temperature sensors are Negative Temperature Coefficient (NTC) sensors. The resistance of these sensors decreases as the temperature of the sensor increases.

NTC sensors have a linear section in the middle of their temperature range, with increased non-linearity above and below the linear temperature section.

The Wolf3D is not affected by non-linear Temperature Sensors. The Wolf3D does not use a mathematical equation to determine the temperature of a sensor at a given resistance. Instead, there are Calibration Tables, allowing exact calibration of each sensor being used. These “Cal Tables” are calibrated every 2 Degrees Celsius.



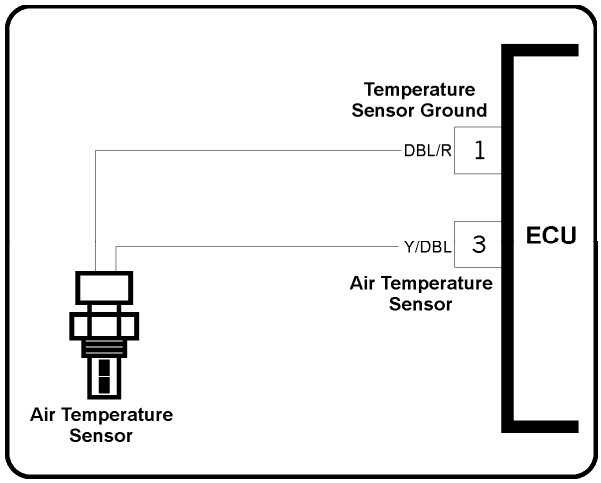
3.3.2 Air Temperature Sensor

The Air Temperature Sensor is used by the Wolf3D to determine how much fuel and ignition timing to add or subtract at various intake air temperatures.

The Air Temperature Sensor is to be placed in such a way as to measure the temperature of the intake air as accurately as possible.

In a naturally aspirated installation the Air Temperature Sensor should be placed in the air intake system.

In a Turbo or Supercharged engine, the Air Temperature Sensor must be mounted after the Turbo or Supercharger, and after any intercooler, or aftercooler.



The Air Temperature Sensor is calibrated using a calibration file that is loaded into the ECU from the PC software.

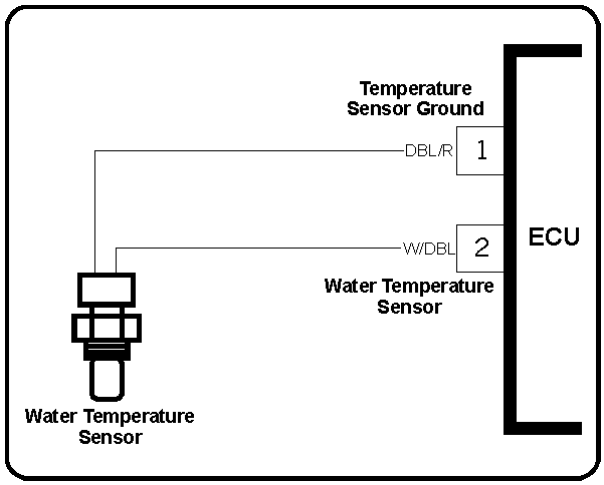
Description	Pin Allocation	Wire Colour
Air Temperature Signal	3	Yellow/Dark Blue
Air Temperature Ground	1	Dark Blue/Red

3.3.3 Water Temperature Sensor

The Water Temperature Sensor is used by the Wolf3D to determine how much fuel and ignition timing to add or subtract at various engine Water Temperatures. This is extremely important for cold engine starting and running.

One of the most important things to remember when installing the Water Temperature Sensor is to ensure that the sensor ground is in very good condition.

The Water Temperature Sensor must be mounted under the thermostat. This allows the ECU to read the Water Temperature as the engine warms up before the thermostat opens for the first time. If the Water Temperature Sensor is placed above the thermostat, the ECU will think the water temperature is lower than it really is during the engine warm-up phase causing the engine to run richer than required during this phase.



The Water Temperature Sensor is calibrated using a calibration file that is loaded into the ECU from the PC software.

Below is a chart of some of the Water Temperature Sensors available for use with the Wolf3D Version 4.

Wolf3D Reference Name	Manufacturer	Manufacturer's Part Number - Reference	Mounting Style
Delco Air Temp Sensor 1	Delco		M14 x 1.5
VDO 150 Temp Sensor	VDO	320 007	M14 x 1.5
VDO 150 Temp Sensor	VDO	320 010	M12 x 1.5
VDO 150 Temp Sensor	VDO	320 013	M22 x 1.5
VDO 150 Temp Sensor	VDO	320 014	M26 x 1.5
VDO 150 Temp Sensor	VDO	320 015	M20 x 1.5
VDO 150 Temp Sensor	VDO	320 016	1/2" - 20 UNF
VDO 150 Temp Sensor	VDO	320 017	3/4" - 16 UNF
VDO 150 Temp Sensor	VDO	320 018	Dip Stick
VDO 150 Temp Sensor	VDO	320 019	Dip Stick
VDO 150 Temp Sensor	VDO	320 021	1/8" - 27 NPTF
VDO 150 Temp Sensor	VDO	320 023	3/8" - 18 Dry Seal
VDO 150 Temp Sensor	VDO	320 025	1/2" - 14 NPTF
VDO 150 Temp Sensor	VDO	320 028	1/8" - 27 NPTF

Please refer to the User Guide for more information about Temperature Sensor Calibration.

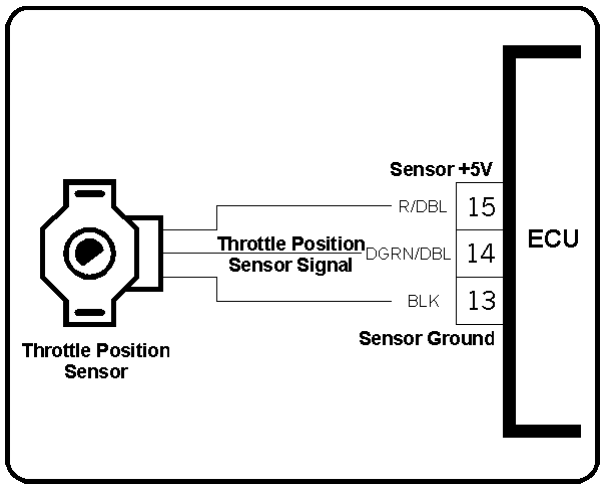
Description	Pin Allocation	Wire Colour
Water Temperature Signal	2	White/Dark Blue
Temperature Ground	1	Dark Blue/Red

3.3.4 Throttle Position Sensor

The Throttle Position Sensor can be used to determine Engine Load, but most often, it is used to determine when the throttle has been moved. Changes in the Throttle Position are called Transients. Fueling and ignition changes must be made due to these Transients. Things like, Acceleration Enrichment and Deceleration Enleanment are required when the throttle moves. They enable good engine response and maintain consistent Air:Fuel Ratios.

The Throttle Position Sensor is a variable resistor that changes value as the throttle is opened.

The Throttle Position Sensor is calibrated using the Hand Controller, or the Wolf3D PC Software.



Refer to the User Guide for more information on Throttle Position Sensor calibration.

Description	Pin Allocation	Wire Colour
TPS +5V	15	Red/Dark Blue
TPS Signal	14	Dark Green/Dark Blue
TPS Ground (Signal Ground)	13	Black

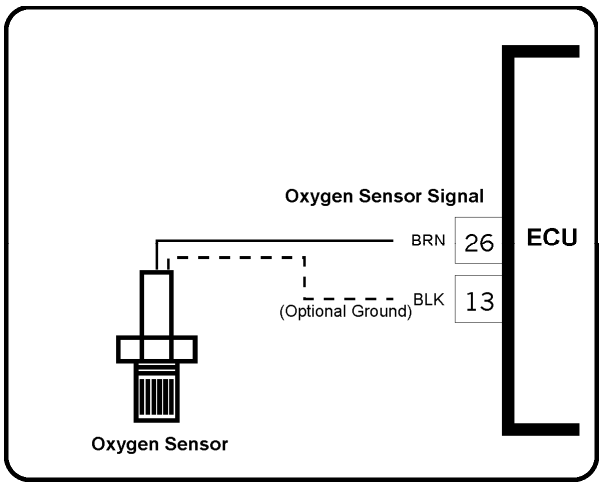
3.3.5 Oxygen Sensor

There are two types of Oxygen Sensor, Narrow Band and Wide Band. For closed loop control when using a catalytic converter, you should use a Narrow Band Oxygen Sensor. Most oxygen sensors in modern cars using unleaded petrol are compatible with the Wolf3D Version 4 ECU.

If you wish to see accurate Air : Fuel Ratios, you must use a Wide Band Oxygen Sensor. The Wolf3D Version 4 is calibrated to the Bosch LSM-11 sensor only.

3.3.5.1 Narrow Band Oxygen Sensor

The Oxygen Sensor can be used to get an indication if the engine is running rich or lean. It can also be used for Closed Loop Control, with the ECU maintaining an Air:Fuel Ratio of 14.7:1. Closed Loop Control is only required when the engine has a catalytic converter. If the engine does not have a catalytic converter, there is no need to use Closed Loop Control.



The Oxygen Sensor must be mounted as close to the engine as possible to enable it to heat up as quickly as possible and to remain hot when the engine is idling, or coasting. When using a heated sensor, the location is less important.

You will have to check the sensor you have to determine the pinouts of the sensor.

There are 1, 2, 3 and 4 wire Oxygen Sensors.

Single wire sensors have only a signal output wire, and use the exhaust manifold and engine as the signal ground. These sensors are the most likely to have signal problems, since the all important sensor ground is prone to corrosion and bad earthing. Also, they are not heated, and must be mounted as close as possible to the exhaust manifold.

Connect the Sensor Ground to Pin 13 on the Wolf3D Version 4. This same pin is used for the TPS Ground.

Description	Pin Allocation	Wire Colour
Oxygen Sensor Input	26	Brown
Signal Ground	13	Black

3.3.5.2 Wideband Oxygen Sensor

The Wideband Oxygen Sensor compatible with the Wolf3D Version 4 is the Bosch LSM-11. Only this sensor is compatible with the Wolf3D Version 4 Wideband Oxygen Sensor Input.

The Air : Fuel Ratio is displayed on the Wolf3D Hand Controller. There is no Air : Fuel Ratio displayed on the PC Software. The displayed range is from 9.8 : 1 to 23.6 : 1.

This sensor, combined with the Wolf3D, can show you accurate Air : Fuel Ratios from very rich, to very lean conditions. These sensors have a limited life, and this is greatly reduced if used with lead fuels. It is not recommend that you leave the LSM-11 sensor in your exhaust system when you are not using it to monitor the Air : Fuel Ratio.

There is a Wideband Sensor Adaptor Loom that plugs directly into the Wolf3D Version 4 loom, and adapts the LSM-11 sensor to the Wolf3D.

Description	Pin Allocation	Wire Colour
Oxygen Sensor Input	26	Brown
Wideband Signal Ground	22	Green/Blue

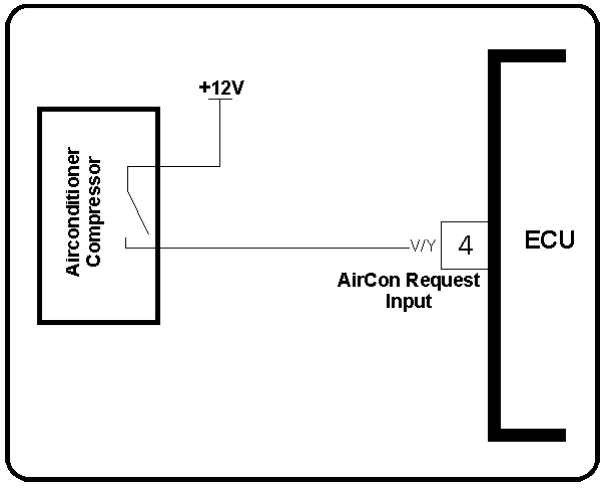
3.3.6 Aircon Request

Aircon Request is an input used by the ECU to determine when the Air Conditioner Compressor is turned on.

When the Air Conditioner is turned on, there is more drag placed on the engine, hence the RPM decreases.

The Aircon Request is an input.

When the Air Conditioner is turned on, 12V is applied to the Air Conditioner compressor clutch, a signal is sent to the ECU. When the ECU receives the signal, the idle speed control valve is opened futher to ensure the engine speed does not decrease due to the extra engine load.



Description	Pin Allocation	Wire Colour
Aircon Request	4	Violet/Yellow

3.3.7 Auxiliary Inputs

Auxiliary 1 and Auxiliary 2 can be used for either Input or Output Functions. You cannot use either of these Auxiliaries as an Input and an Output at the same time.

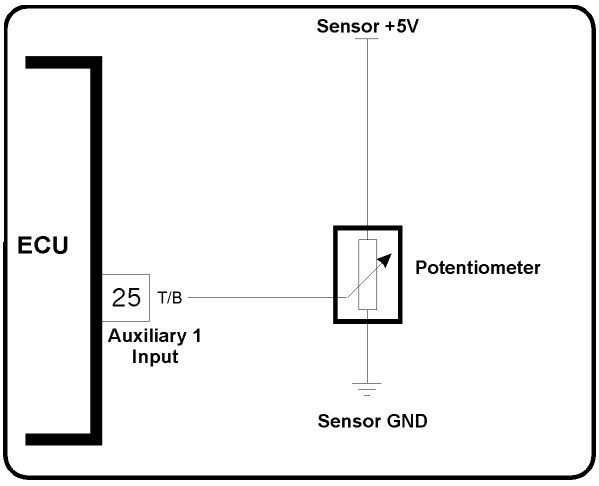
Functions that can use an Auxiliary Input to trim their values are:

Fuel Injection
Ignition Timing
Boost Control

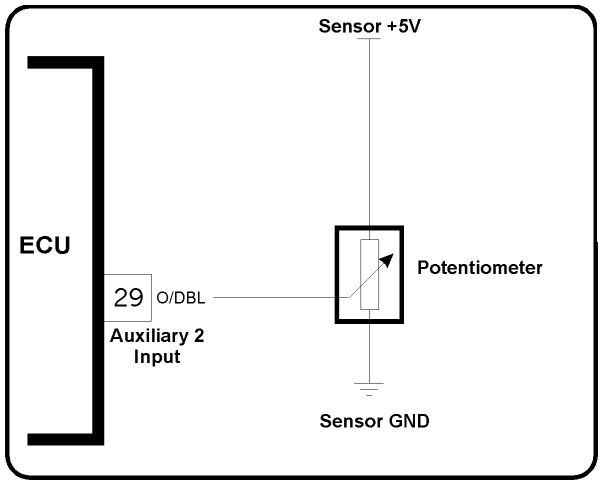
Although you can use almost any type of potentiometer, it is best to use one that is a 5K linear potentiometer.

You can calibrate the voltage input for each of the functions.

When the output of the Potentiometer is GND, the Aux light on the ECU will turn on.



When the output of the Potentiometer is +5V, the Aux light on the ECU will turn off.



Description	Pin Allocation	Wire Colour
Auxiliary Input 1	25	Tan/Black
Auxiliary Input 2	29	Orange/Dark Blue

3.4 Outputs - General

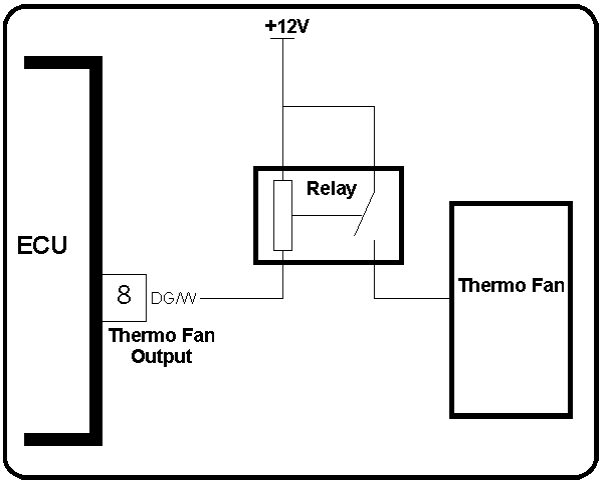
3.4.1 Thermo Fan

When the Wolf3D Version 4 turns on the Thermo Fan, the output pin pulls to ground. This output pin must be wired to a relay, that then switches power to the Thermo Fan.

Do not wire any electrical components to the starter motor or starter motor solenoid. This can cause major problems with any electrical components during engine cranking.

The Thermo Fan Output is current limited to avoid any harm to the ECU, even if the output is connected directly to +12V.

Use a relay that is “Normally Open”.



Description	Pin Allocation	Wire Colour
Thermo Fan Output	8	Dark Green/White

3.4.2 Idle Speed Control Solenoid

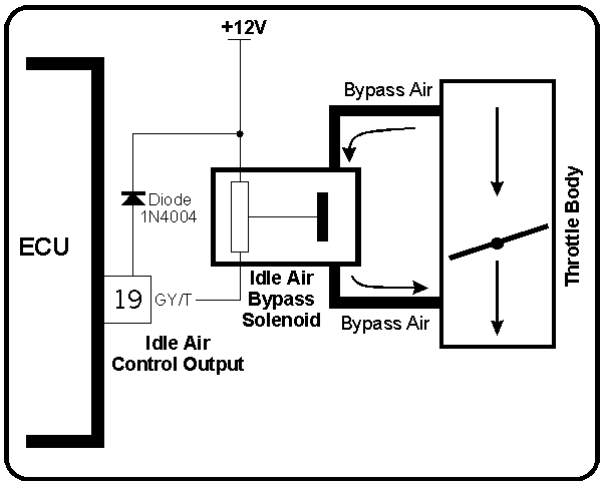
When the Wolf3D Version 4 pulses the Idle Speed Control Solenoid, the output pin pulls to ground.

The output of this pin is called Pulse Width Modulation (PWM). This means that the ECU continues to output pulses on this pin, and only the amount of time that the pin is pulled to ground is changed. The longer that the pin is pulled to ground, for each pulse, the more open the Idle Speed Control Valve is and hence, more air is flowed through the valve, increasing the engine RPM.

The Idle Speed Control Solenoid driver is current limited to avoid any harm to the ECU, even if the output is connected directly to +12V.

You must place a diode across the power and signal wires of the Idle Speed Control Solenoid. Please refer to the wiring diagrams at the rear of this manual for more information on wiring in PWM Idle Speed Control Solenoid.

The minimum resistance of any Idle Air Bypass solenoid must be 1.2Ohms. If you use a solenoid with a resistance lower than 1.2Ohms, an unstable idle will result.



Description	Pin Allocation	Wire Colour
Idle Speed Control	19	Gray/Tan

3.4.3 Boost Control Solenoid

When the Wolf3D Version 4 pulses the Boost Control Solenoid, the output pin pulls to ground.

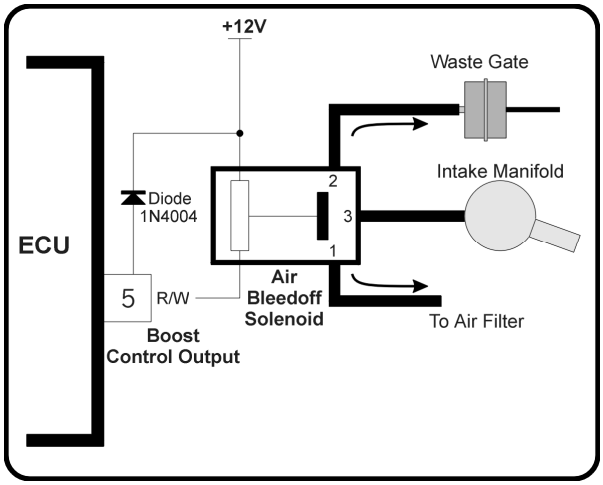
The output of this pin is called Pulse Width Modulation (PWM). This means that the ECU continues to output pulses on this pin, and only the amount of time that the pin is pulled to ground is changed. The longer that the pin is pulled to ground, for each pulse, the more open the Boost Control Solenoid is and hence, the more air is bled off from the Turbo wastegate.

The Boost Control Solenoid driver is current limited to avoid any harm to the ECU, even if the output is connected directly to +12V.

You must place a diode across the power and signal wires of the Boost Control Solenoid. Please refer to the wiring diagrams at the rear of this manual for more information on wiring in PWM Boost Control Solenoid.

The minimum resistance of any Boost Control Solenoid is 1.2Ohms. If you use a solenoid with a resistance lower than 1.2Ohms, an unstable idle will result.

We can recommend valves to suit the Boost Control Application.



Description	Pin Allocation	Wire Colour
Boost Control	5	Red/White

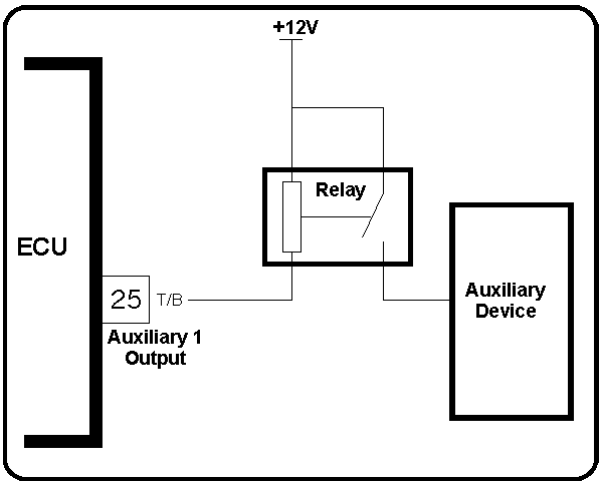
3.4.4 Auxiliary Outputs

Auxiliary 1 and Auxiliary 2 can be used for either Input or Output Functions. You cannot use either of these Auxiliaries as an Input and an Output at the same time.

Two fully configurable Auxiliary Outputs are available to you with the Wolf3D Version 4. Either Auxiliary can be configured using several parameters such as RPM, Throttle Position, etc.

Each output is a current limited low side driver. This means that the output pulls the signal wire down to ground when the Auxiliary Output is turned on. The ECU does not supply any voltage to the Auxiliary Output pins.

Use a relay that is “Normally Open”.

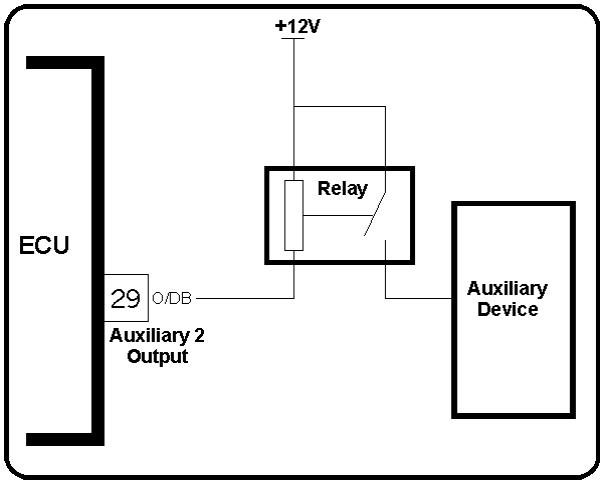


This signal wire must be wired to a relay to switch in or out any device.

Do not wire the Auxiliary Output directly to any device that draws more than 2 amps.

The Auxiliary Output Diagnostic LED’s turn on when the Output pulls low.

Use a relay that is “Normally Open”.



Description	Pin Allocation	Wire Colour
Auxiliary Output 1	25	Tan/Black
Auxiliary Output 2	29	Orange/Dark Blue

4 Ignition System

4.1 Ignition System Requirements

Incorrect or poorly performing ignition components can cause many frustrating problems later on when dyno tuning or when the car is on the track.

Engines with high compression, or forced induction, or engines that run at very high RPM's require very high quality, high-energy ignition systems. In some cases, Capacitor Discharge Ignition (CDI) is required to ensure against engine misfires.

4.2 Ignition System Wiring

It is very important that you do not take ignition system power from areas of the vehicle that can cause any part of the EFI system to have reduced performance.

The ignition system must be wired via a fuse to the battery. This ensures that full power is available to the ignition system. It also ensures that there is no interference on the power supply that can cause problems to other electrical systems on the vehicle.

Do not wire any electrical components to the starter motor or starter motor solenoid. This can cause major problems with any electrical components during engine cranking.

Ensure that your coil igniters are properly earthed. All of the current that flows through the ignition coil also flows through the coil igniter. If the igniter is not earthed properly, there will be reduced current flow through the ignition coil, and this will seriously reduce spark energy.

4.3 Ignition Outputs

There are 4 Ignition Outputs and 1 Tacho Output on the Wolf3D Version 4. The ECU can control up to 4 dual output coils on an 8 cylinder engine. 12 cylinder engines are not supported in Multi-Coil operation.

Each output is a +5V square wave output. This output must be connected to either an inductive or CDI ignition system, before the signal is routed to the ignition coils.

Do not connect the Ignition Outputs of the Wolf3D directly to the ignition coils. ECU damage may result. You must connect the ECU to coil igniters that are ECU compatible, and are compatible with the ignition coils that you are using.

The Tacho Output is a +12V square wave. This square wave is compatible with almost all Tachometers, although some of Tachometers are not compatible with this Tacho Output. For any Tachometers that are not compatible, wire the Tachometer to the ignition coil in the way recommended by the Tachometer manufacturer.

Description	Pin Allocation	Wire Colour
Ignition 1	32	Red
Ignition 2	33	Yellow
Ignition 3	34	Gray
Ignition 4	16	Dark Green
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

The first thing to determine is the firing order of your engine. You can then determine which cylinders are the 1st, 2nd, 3rd, 4th, etc, in the engine's firing order.

Write your engine's firing order in the table below.

Cylinder Order	1st	2nd	3rd	4th	5th	6th
Engine Firing Order						

Cylinder Order	7th	8th	9th	10th	11th	12th
Engine Firing Order						

4.3.1 Rotor Button Phasing

If you are using a distributor ignition system, you must lock the distributor shaft in a position that allows you to position the Rotor Button directly at the electrode for piston 1/ rotor 1 leading in the distributor cap when the crankshaft is placed at 22°BTDC.

Rotor Button Phasing is required no matter what type of input trigger you are using, and the crankshaft /eccentric shaft angles for phasing remain the same in all cases.

This setting is vital to ensure the spark does not run off either end of the rotor button when either extremely high, or extremely low advance is used.

Incorrect Rotor Button phasing will cause hard starting, engine misfiring, engine crossfiring, bad emissions, and increased fuel consumption.

The same principle applies to both piston and rotary engines using distributor ignition systems.

4.3.1.1 Step By Step Rotor Button Phasing

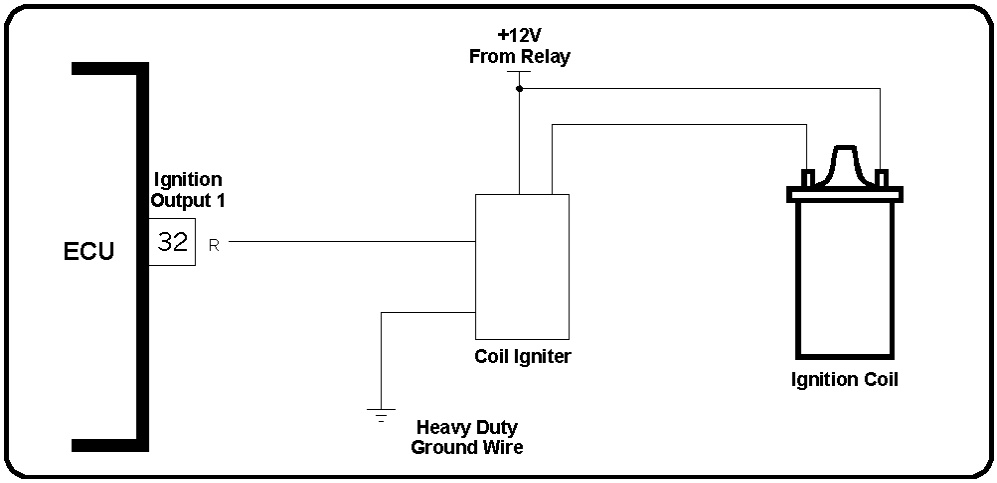
- **Put the distributor cap onto the distributor.**
- **Mark on the outside of the distributor housing to indicate where the electrode for the first cylinder/rotor is.**
- **Rotate the crankshaft to 22°BTDC.**
- **With the rotor button in place, rotate the distributor housing until the rotor button is pointing directly at the mark you have made on the housing.**
- **Tighten the distributor clamping bolt.**
- **Do NOT loosen the clamping bolt again. This is the position the distributor housing must be placed to ensure correct Rotor Button Phasing.**

The Rotor Button is now setup correctly. If you have a Dual Distributor engine, refer to the section describing the ignition system for Dual Coil Piston Engines.

4.3.2 Single Coil (Piston Engines)

Using a single coil on a piston engine is the simplest, and in many cases the most practical way to configure the ignition system of your engine.

Depending on the engine speed and cylinder pressures, the ignition system may be a limitation when using a single coil. Talk to your engine builder, or EFI specialist before committing to a single coil ignition system. You might find the limit of the ignition system, and is would have been better to determine if your ignition system was a problem in the beginning before any installation took place.
The ECU must be in Distributor Mode (Dist). Refer to the User Guide for more information about ignition output configuration.



This system does not require a Dual Pulse Input Trigger.

Description	Pin Allocation	Wire Colour
Ignition 1	32	Red
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

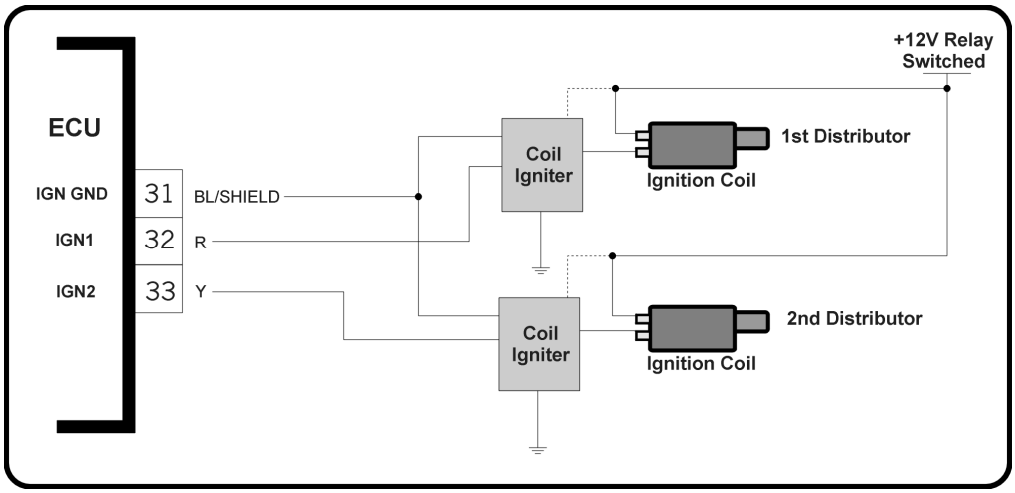
4.3.3 Dual Coil (Piston Engines)

Some engines with high numbers of cylinders (usually 8 or more) have either two distributors, or a twin height distributor. Two Ignition Coils are used in this configuration, with half of the cylinders controlled by one coil and distributor, and the other half controlled by the second coil and distributor.

The ignition events swap between the first and second distributor with each spark event.

4.3.3.1 8 Cylinder Dual Coil Dual Distributor

8 Cylinder Engines can be run in Dual Coil, Dual Distributor configuration. The system uses 2 single outlet ignition coils. Each coil is connected to one of the distributors.



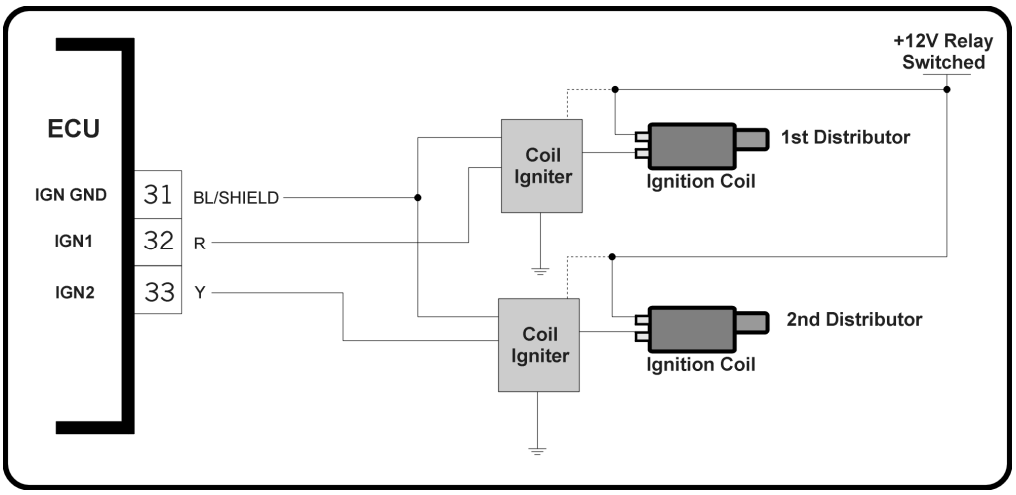
You must use an 8 Cylinder Dual Pulse Input Trigger system when using a Dual Coil, Dual Distributor ignition system.

The 1st Distributor is for the 1st, 3rd, 5th and 7th Cylinders in the firing order.
The 2nd Distributor is for the 2nd, 4th, 6th and 8th Cylinders in the firing order.

It is important to have correct rotor button phasing on both distributors. The first distributor must be setup to have the rotor button pointing at the electrode for cylinder number 1 in the distributor cap at 22°BTDC. The second distributor must have the rotor button pointing at the electrode for the second cylinder in the firing order at 68°ATDC.

4.3.3.2 10 Cylinder Dual Coil Dual Distributor

10 Cylinder Engines can be run in Dual Coil, Dual Distributor configuration. The system uses 2 single outlet ignition coils. Each coil is connected to one of the distributors.



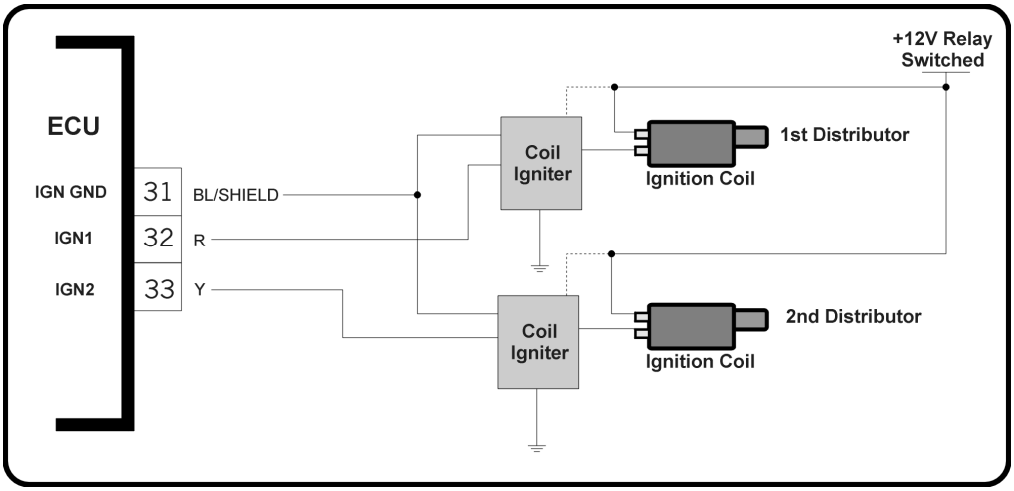
You must use a 10 Cylinder Dual Pulse Input Trigger system when using a Dual Coil, Dual Distributor ignition system.

The 1st Distributor is for the 1st, 3rd, 5th, 7th and 9th Cylinders in the firing order.
The 2nd Distributor is for the 2nd, 4th, 6th, 8th and 10th Cylinders in the firing order.

It is important to have correct rotor button phasing on both distributors. The first distributor must be setup to have the rotor button pointing at the electrode for cylinder number 1 in the distributor cap at 22°BTDC. The second distributor must have the rotor button pointing at the electrode for the second cylinder in the firing order at 50°ATDC.

4.3.3.3 12 Cylinder Dual Coil Dual Distributor

12 Cylinder Engines can be run in Dual Coil, Dual Distributor configuration. The system uses 2 single outlet ignition coils. Each coil is connected to one of the distributors.



You must use a 12 Cylinder Dual Pulse Input Trigger system when using a Dual Coil, Dual Distributor ignition system.

The 1st Distributor is for the 1st, 3rd, 5th, 7th, 9th and 11th Cylinders in the firing order.
The 2nd Distributor is for the 2nd, 4th, 6th, 8th, 10th and 12th Cylinders in the firing order.

It is important to have correct rotor button phasing on both distributors. The first distributor must be setup to have the rotor button pointing at the electrode for cylinder number 1 in the distributor cap at 22°BTDC. The second distributor must have the rotor button pointing at the electrode for the second cylinder in the firing order at 38°ATDC.

4.3.4 Multi Coil (Piston Engines)

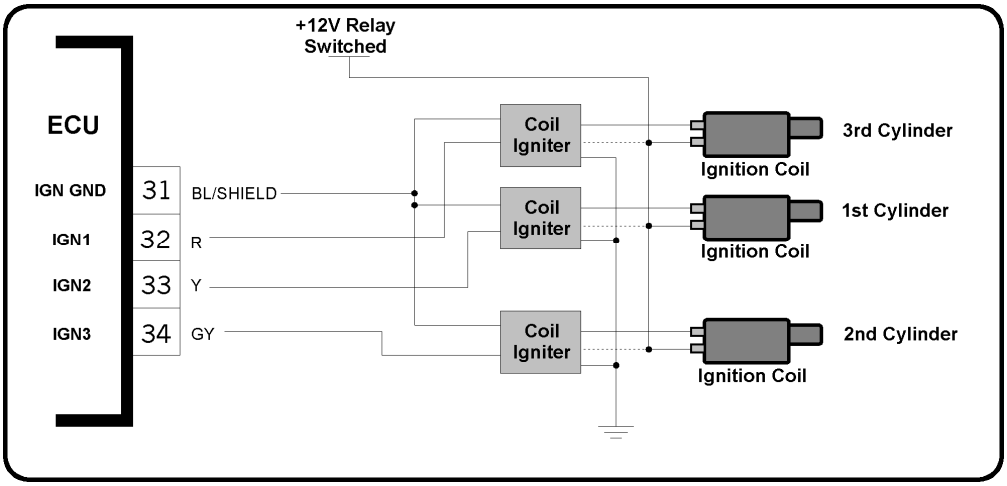
The next step up from a good single coil ignition system is a multi coil system.

Multi-coil Piston Engines can be further divided into 2 subclasses:

1. Dual Outlet Wasted Spark Ignition: The two sparkplugs are fired at the same time. This is possible by choosing pairs of sparkplugs that are in "opposing cylinders". Opposing cylinders are ones whose pistons are moving up and down together. For Example, on a 6 cylinder with firing order 1,5,3,6,2,4 the opposing cylinders are (1,6) (5,2) (3,4). It is safe to fire pairs of sparkplugs in opposing cylinders at the same time without fear of backfire.

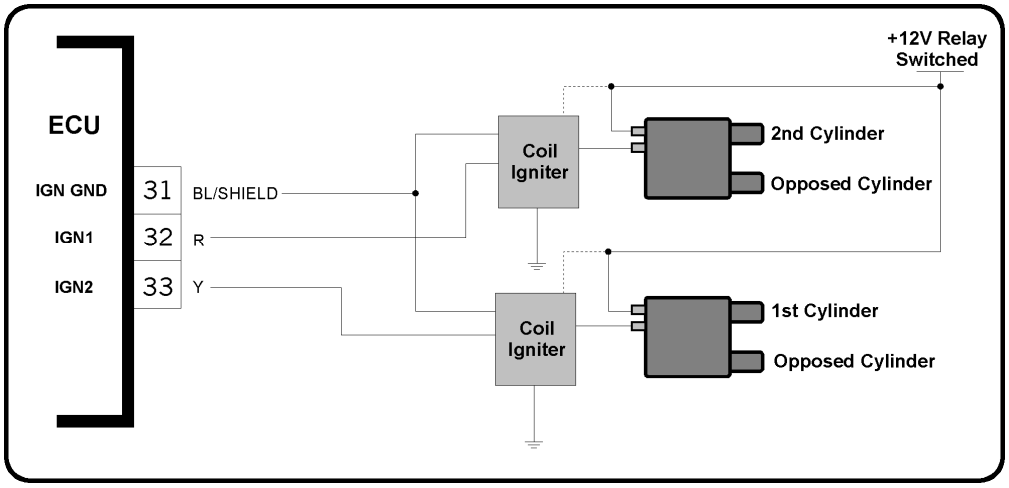
2. Single Outlet Spark Ignition: Each cylinder has its own coil. Coils can be fired sequentially (up to 4 cylinders), or as a Wasted Spark system. This system allows for the very best ignition system, since full spark energy goes to each cylinder. The Wolf3D Version 4 has 4 ignition outputs; hence you can have individual ignition outputs on engines up to 4 cylinders.

4.3.4.1 3 Cylinder Single Outlet Coil Waste Spark



3 individual Single Outlet Coils are a neat way of solving 3 Cylinder Engine ignition problems. Each coil is fired on the compression and exhaust stroke of each cylinder.
Run the engine as though it is a 6 Cylinder, with the same Crankshaft Sensor configuration, or run it as a 3 Cylinder with a Camshaft Sensor, and wire the Ignition Coils as above.

4.3.4.2 4 Cylinder Dual Outlet Coil Waste Spark

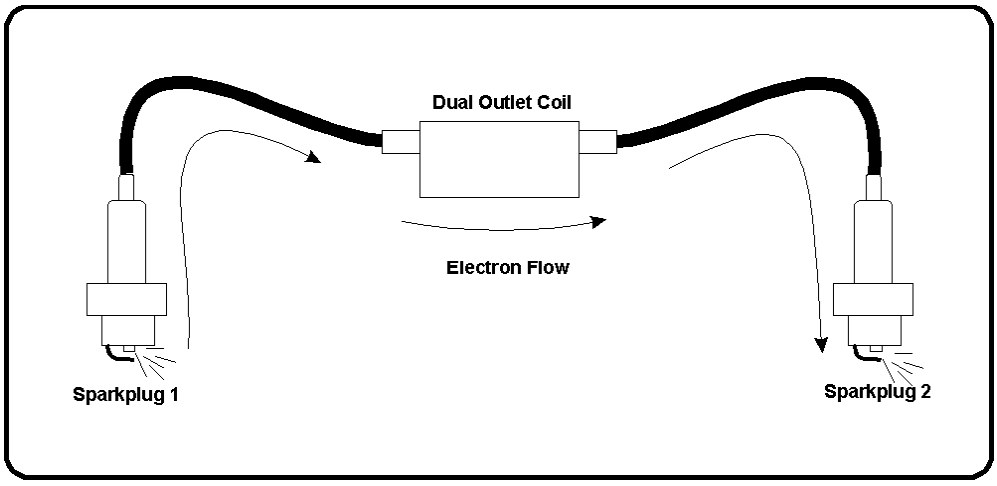


The most common type of ignition system used on 4 cylinder engines is the Waste Spark system. The system uses 2 dual outlet ignition coils. Each coil is connected to each pair of sparkplugs of 2 opposing cylinders.

This system requires a Dual Pulse Input Trigger.

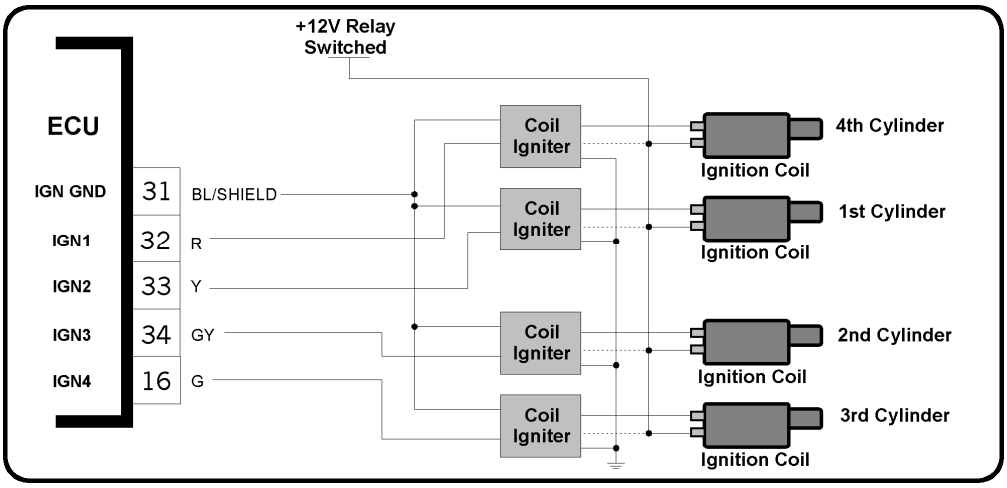
Description	Pin Allocation	Wire Colour
Ignition 1	32	Red
Ignition 2	33	Yellow
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

The spark energy travels from the ground electrode of one sparkplug, causing a spark, through the coil, and down to the electrode of the other sparkplug causing the other spark. Both sparks occur at the same time. There is a disadvantage to this system, in that one spark is always stronger than the other. On high



performance applications, this can lead to ignition breakdown and engine misfires.

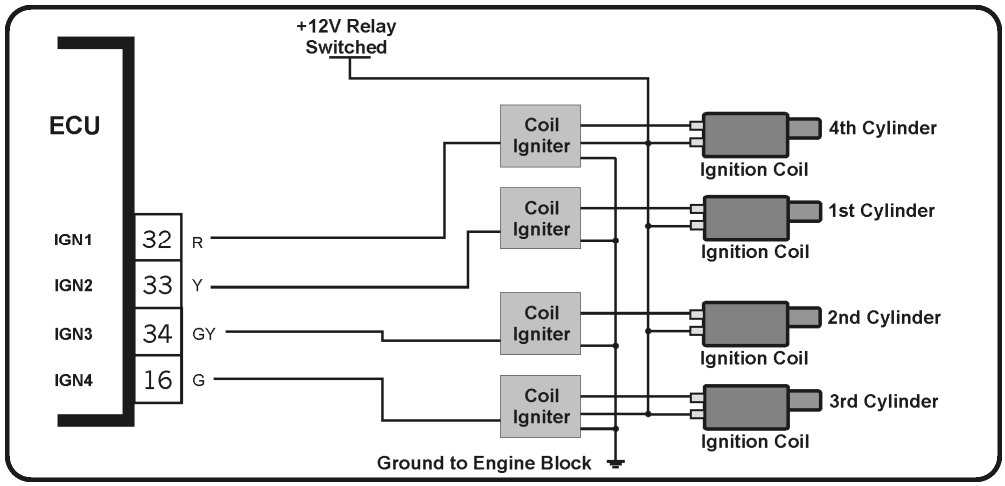
4.3.4.3 4 Cylinder Single Outlet Coil Waste Spark



A better system to use for Waste Spark, is to have 4 individual coils, one for each cylinder. Sparkplugs are still fired in pairs, but full energy from each coil goes to each sparkplug. This system is far more robust than a Waste Spark system using dual outlet ignition coils.
This system requires a Dual Pulse Input Trigger.

Description	Pin Allocation	Wire Colour
Ignition 1	32	Red
Ignition 2	33	Yellow
Ignition 3	34	Gray
Ignition 4	16	Dark Green
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

4.3.4.4 4 Cylinder Single Outlet Coil Sequential Spark

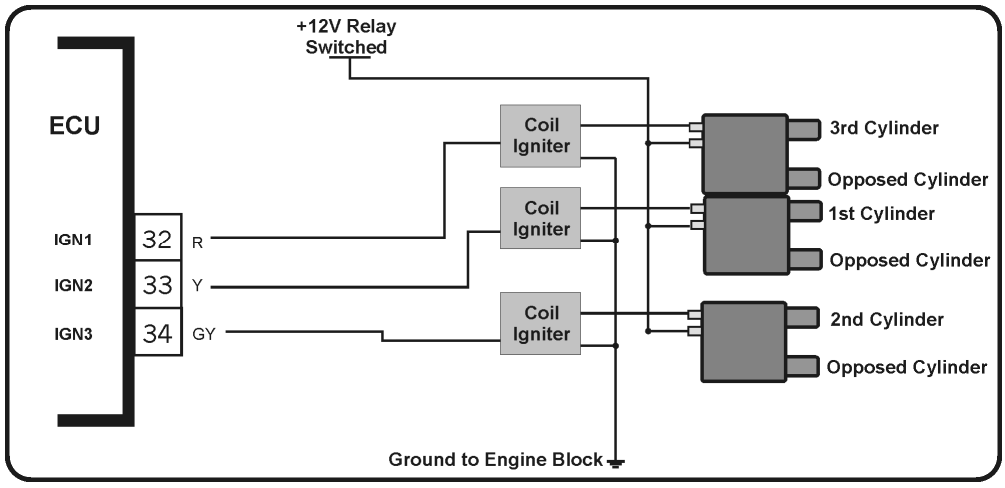


The best system to use on a 4 cylinder engine is to have one ignition coil per cylinder, and fire them in sequence. This means that each coil is fired only once per engine cycle, and that maximum spark energy is applied to each cylinder.

This system requires a Camshaft Sync signal.

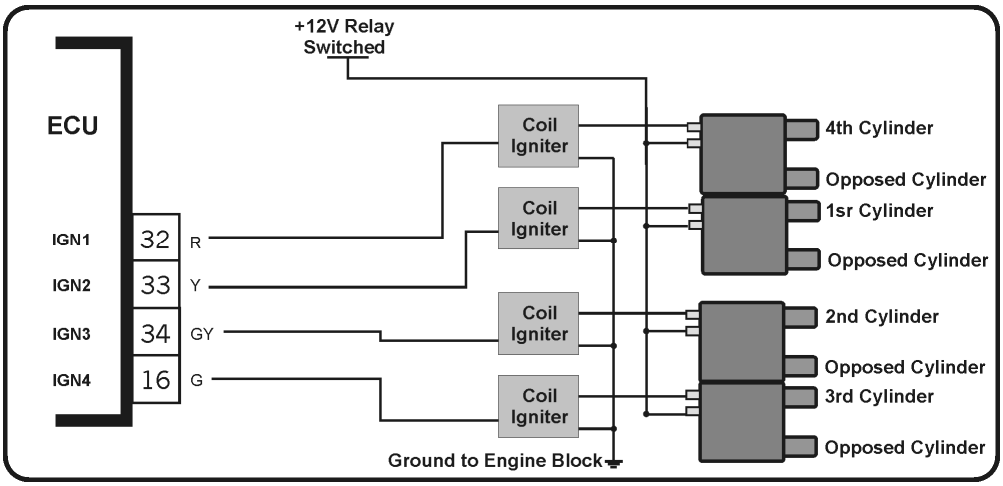
Description	Pin Allocation	Wire Colour
Ignition 1	32	Red
Ignition 2	33	Yellow
Ignition 3	34	Gray
Ignition 4	16	Dark Green
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

4.3.4.5 6 Cylinder Dual Outlet Coil Waste Spark



6 Cylinder Engines can be run in Multicoil Wasted Spark configuration. The system uses 3 dual outlet ignition coils. Each coil is connected to the sparkplugs of 2 opposing cylinders.

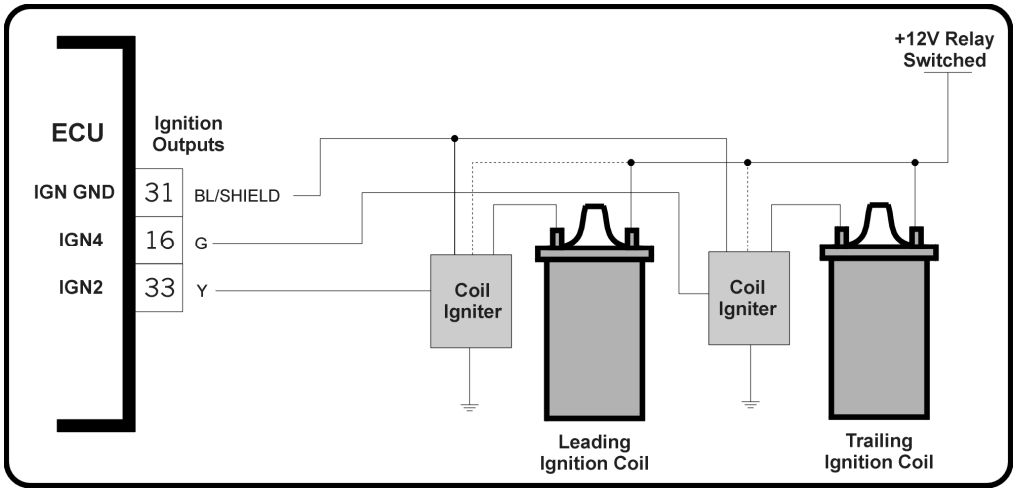
4.3.4.6 8 Cylinder Dual Outlet Coil Waste Spark



8 Cylinder Engines can be run in Multicoil Wasted Spark configuration. The system uses 4 dual outlet ignition coils. Each coil is connected to the sparkplugs of 2 opposing cylinders.

4.3.5 Dual Coil (Rotary Engines)

There is a special output mode for Dual Coil rotary engine applications. In this mode the timing of the two ignition coils (Leading and Trailing), are controlled by the ECU, but the distributor is still used for spark distribution. This simplifies the installation of ignition control for rotary engines, as the original distributor can be modified to be a Single Pulse Cam Trigger. Correct distributor setup is essential for this, or whenever a distributor is used for spark distribution.



Description	Pin Allocation	Wire Colour
Ignition 2	33	Yellow
Ignition 4	16	Dark Green
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

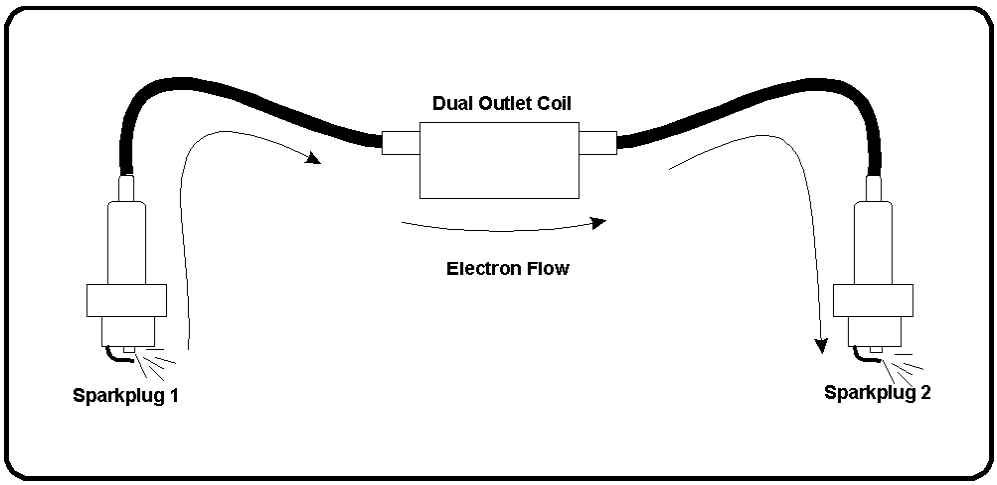
4.3.6 Multi Coil (Rotary Engines)

The most popular type of installation for ignition control on rotary engines is multi coil installations. This is because Rotary engines require a high-energy ignition system. Multi Coil Ignition systems generally offer more spark energy than distributor ignition systems.

There are two types of Rotary Multi Coil ignition systems.

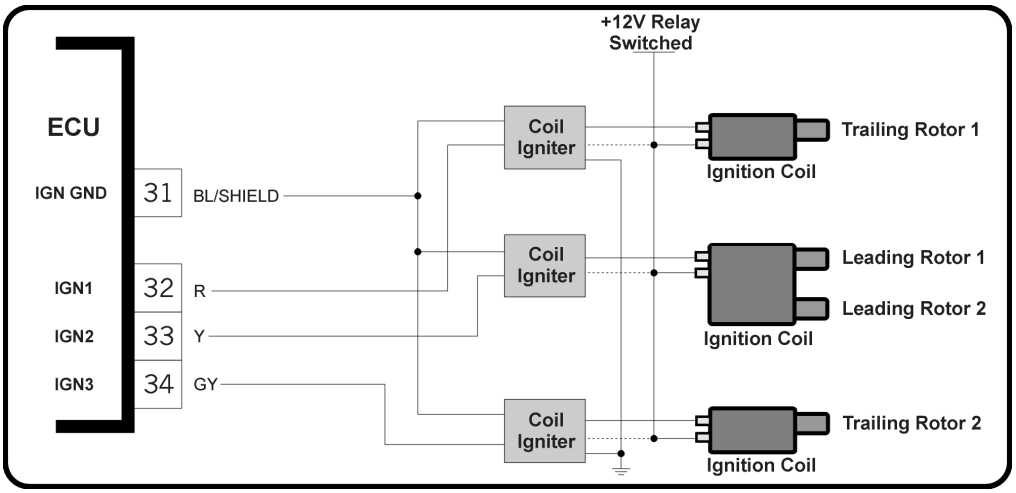
1. One Dual and two Single Coils
2. Four Single Coils (one coil per sparkplug)

We strongly recommend using one coil per sparkplug on all rotary applications. This is because of the high-



energy requirement placed on ignition systems used on rotary engines. Dual Output coils, although having a high secondary voltage, are biased to one of their outputs, causing one output to have weaker spark than the other.

4.3.6.1 2 Rotor 2 Single Outlet and 1 Dual Coil Wasted Spark on Leading Coils

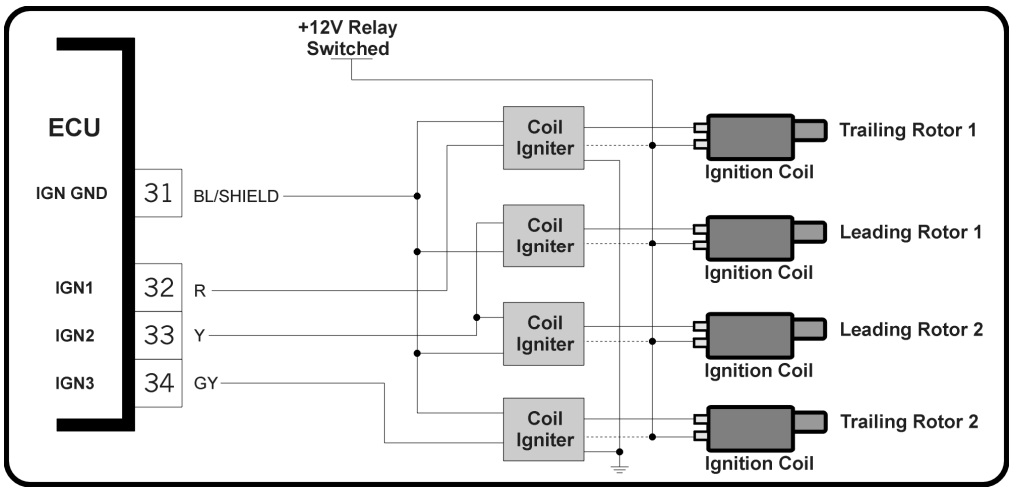


Standard Mode is used with Aftermarket ignition coils, and late model Mazda rotary Ignition systems.

This system requires a Crankshaft Dual Pulse signal.

Description	Pin Allocation	Wire Colour
Ignition 1	32	Red
Ignition 2	33	Yellow
Ignition 3	34	Gray
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

4.3.6.2 2 Rotor 4 Single Outlet Coil Wasted Spark on Leading Coils



Using 4 Single Outlet coils on a 2 Rotor engine will give you the very best ignition system power that you can get for a rotary engine.

The most important coils on a rotary engine are the leading coils. The leading coils spark up to 20 degrees before the trailing coils, and hence burns most of the fuel, supplying most of the engine power.

This system requires a Crankshaft Dual Pulse signal.

Description	Pin Allocation	Wire Colour
Ignition 1	32	Red
Ignition 2	33	Yellow
Ignition 3	34	Gray
Ignition Ground	31	Blue/Shield
Tacho Output	17	Violet

5 Fuel System

The Fuel System itself is the starting point for any EFI installation, from the fuel tank, through the fuel pump, up to the engine, past the injectors, through the regulator, and back down the return line. The fuel system must be both, the correct fuel system size and quality. Cleanliness is very important to ensure a smooth installation and easy engine tuning.

5.1 Fuel System Size Requirements

As engine size and power increase, the fuel system must be sized to suit. If the fuel system is not sized correctly, there will be problems that may only appear when the fuel system is placed under maximum load. During dyno tune situations, and road testing this weakness may not be exposed. It may only appear on the race track.

It is very important to talk to a qualified person before committing to a fuel system. Asking for advice costs nothing, but dyno time and potential engine damage can be very expensive if a fuel system that is not up to the demands of the engine is installed.

5.2 Fuel System Plumbing

Correct fuel system plumbing is very important. This is a safety issue, so no shortcuts can be taken with fuel system components or installation.

Use only high quality fittings, new if possible, and only use clamps and hose that are designed for high-pressure EFI installations.

- Use only correct sized fuel hose for each fitting.
- Never use spring clips for any fuel hoses on an EFI installation.
- Make sure that the hose clamps are not cutting into the fuel hose.

Old hoses are very dangerous. If you take into account the cost of the ECU, installation and tuning, a few extra dollars spent on replacing old or low quality hose, can ensure a successful and safe EFI installation.

There are two major types of Fuel Systems:

Fuel System including Anti-Surge Tank

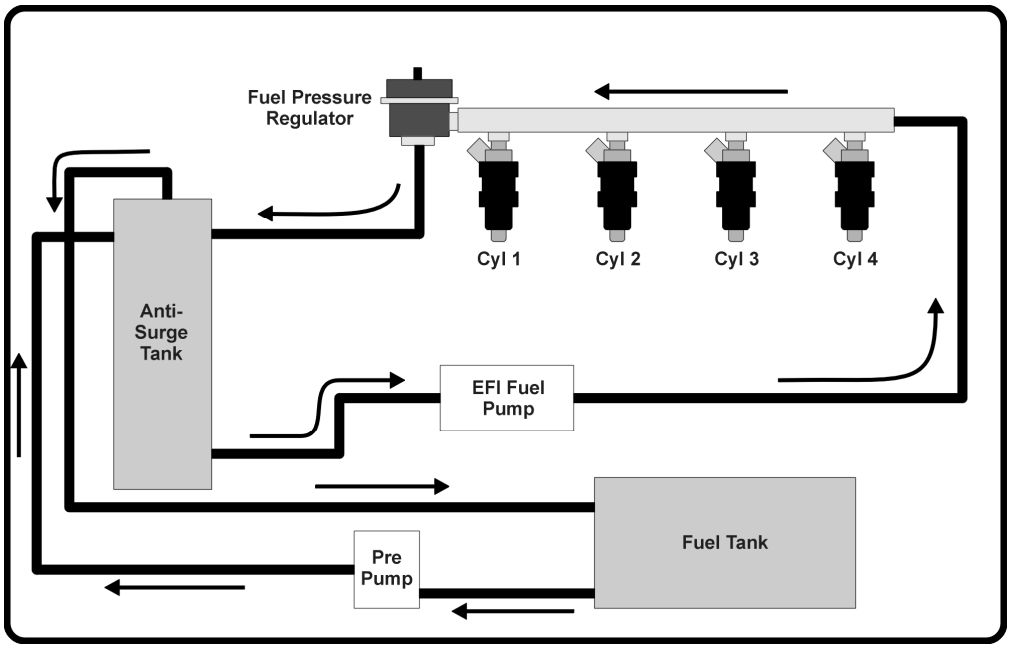
Fuel System without Anti-Surge Tank

5.2.1 Fuel System with Anti-Surge Tank

You must use an Anti-Surge Tank when the main fuel tank does not have a drop anti-surge tank, or has not been designed for EFI use.

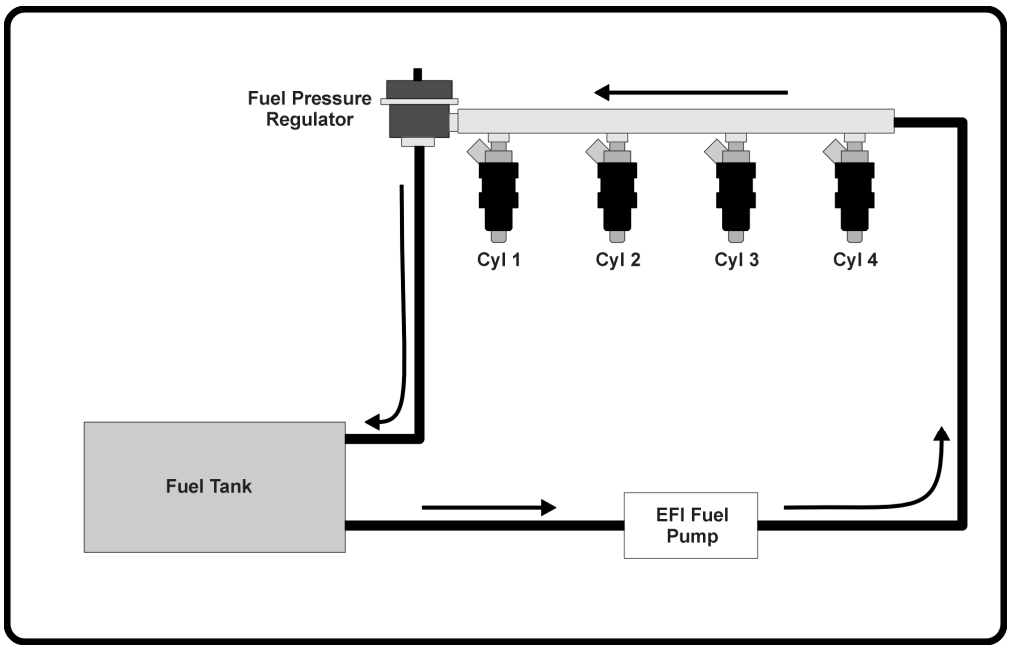
Make sure your Pre-pump can flow enough fuel for your engine's requirements.

Below is a diagram describing the fuel system including an anti-surge tank.



Fuel System with no Anti-Surge Tank

If your main fuel tank has been designed for EFI use, you do not have to use an Anti-Surge Tank.



5.3 Fuel System Cleanliness

It is very important to keep all fuel system components very clean. Any dirt or water that gets into the fuel system will cause problems.

Dirt and water can get into injectors causing idle stability problems, and engine misfires.

Clean fuel system components with fuel soluble, non-flammable solvents, and ensure that all components are dry before assembling the fuel system.

Many times, people can't get their engine idling properly, or it misfires on acceleration. This problem is often traced back to dirty injectors, or a clogged fuel filter.

If the engine has not been run in the last 2 weeks, have your injectors cleaned and flowed. Make sure you get a written report with each injector numbered, and a flow number for each injector. The injectors should all flow within 5% of each other. Any more variance than that, and you may experience idle stability problems.

The person who cleaned and flowed your injectors should give them back to you in a plastic bag. Keep them in the plastic bags until you are ready to install them in your engine, no more than one week prior to starting the engine for the first time.

5.4 Injectors

The Wolf3D can control electronic fuel injectors designed for petrol engines.

5.4.1 Injector Impedance

Each Injector Output of the ECU can drive an injector load down to 1.2 Ohms. The Wolf3D uses peak and hold, current limited injector drivers, that peak at 4 amps to quickly open the injector, then hold the injector open using 1 amp of current. The injector drivers also have an over temperature cutout, to ensure they are never damaged if the injectors are not wired correctly, or are of too low an impedance for the injector drivers.

As the injector impedance decreases, more current tries to run through the injector drivers of the Wolf3D Version 4. The current limiting injector drivers have to hold back more current, and more heat is generated.

High injector impedances are no problem for the Wolf3D Version 4. As the injector impedance increases, less current passes through the injector, and the injector driver, and generates less heat.

5.4.2 Calculating Injector Impedance

If you are using more than 1 injector on each output of the Wolf3D Version 4, you will need to calculate the total impedance placed on each injector output of the ECU.

Parallel Injectors – When injectors are wired in parallel, the total impedance is less than either of the injectors alone.

If two injectors of equal impedance are wired together in parallel, the total impedance is equal to half the impedance of either injector. If each injector has an impedance of 3.6 Ohms, the total impedance for two injectors in parallel is 1.8 Ohms.

If three injectors of equal impedance are wired together in parallel, the total impedance is equal to one third the impedance of any of the injectors. If each injector has an impedance of 3.6 Ohms, the total impedance for three injectors in parallel is 1.2 Ohms.

The calculation used to determine injectors in parallel is:

$$\frac{1}{R_{total}} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \ldots\ldots$$

Series Injectors – When injectors are wired in series, the total impedance is equal to the impedance of all the injectors on that output added together.

For example: If there are 2 injectors wired in series, and each injector has an impedance of 3.6 Ohms, the total impedance of the two injectors is 7.2 Ohms.

The calculation used to determine injectors in series is:

Rtotal = R1 + R2 + R3 + …….

5.4.3 Injector Wiring Combinations

There are many ways to wire the injectors, depending on the engine type, and the number any type of injectors being used. Refer to the wiring diagrams at the rear of this manual for examples of injector wiring that you can use on your own installation.

The fuel system (fuel pumps and injectors) must be wired via a fuse to the battery. This ensures that full power is available to the ignition system. It also ensures that there is no interference on the power supply that can cause problems to other electrical systems on the vehicle.

Do not source +12V from the starter motor solenoid. This can cause major problems with any electrical components during engine cranking.

Description	Pin Allocation	Wire colour
Injector Output 1	11	Dark Green/Black
Injector Output 2	12	Dark Blue/Black
Injector Output 3	20	Yellow/Black
Injector Output 4	21	White/Black

The first thing to determine is the firing order of your engine. You can then determine which cylinders are the 1st, 2nd, 3rd, 4th, etc, in the engine's firing order. All references to cylinders are references to firing order, not cylinder numbers.

Write your engine's firing order in the table below.

Cylinder Order	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**
Engine Firing Order						

Cylinder Order	**7th**	**8th**	**9th**	**10th**	**11th**	**12th**
Engine Firing Order						

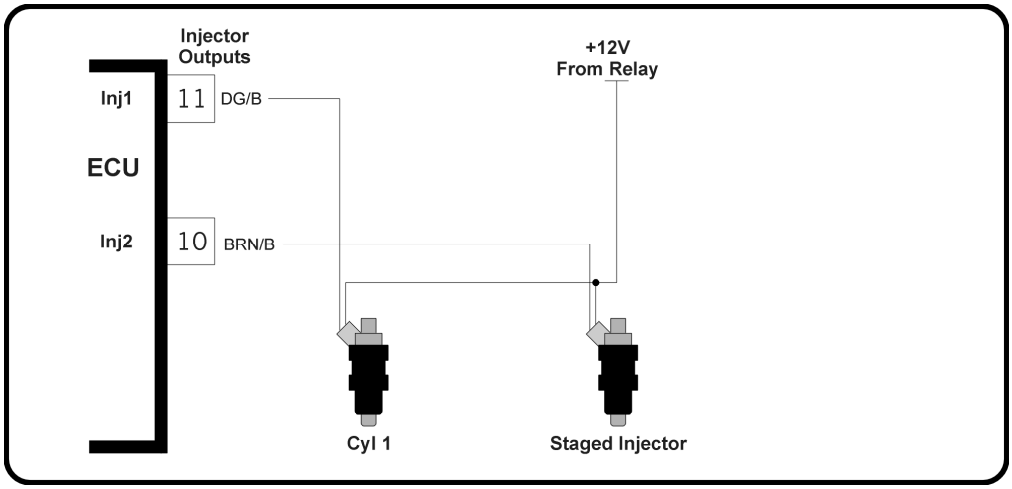
Below is a list of example Primary Injector output configurations.

Engine Type	Injector Bank 1	Injector Bank 2	Injector Bank 3	Injector Bank 4	Staged Injector
1 Cylinder	(Cyl 1st)				
2 Cylinder	(Cyl 1st)	(Cyl 2nd)			
3 Cylinder	(Cyl 1st)	(Cyl 2nd)	(Cyl 3rd)		
4 Cylinder	(Cyl 1st)	(Cyl 2nd)	(Cyl 3rd)	(Cyl 4th)	
5 Cylinder*	(Cyl 1st)	(Cyl 2nd)	(Cyl 3rd)	(Cyl 4th)	(Cyl 5th)
6 Cylinder	(Cyl 1st, 4th)	(Cyl 2nd, 5th)	(Cyl 3rd, 6th)		
8 Cylinder	(Cyl 1st, 5th)	(Cyl 2nd,6th)	(Cyl 3rd, 7th)	(Cyl 4th, 8th)	
10 Cylinder*	(Cyl 1st, 6th	(Cyl 2nd, 7th)	(Cyl 3rd, 8th)	(Cyl 4th, 9th	(Cyl 5th, 10th)
12 Cylinder	(Cyl 1st, 5th, 9th)	(Cyl 2nd, 6th, 10th)	(Cyl 3rd, 7th, 11th)	(Cyl 4th, 8th, 12th)	
2 Rotor	Rotor 1	Rotor 2			
3 Rotor	Rotor 1	Rotor 2	Rotor 3		
*Staged Injection not Available if the Staged Injection Output is used as a Primary Injector Output.					

5.4.3.1 1 Cylinder Injector Configuration

Single Cylinder Engines have only one sparkplug, hence only one injection output is needed for these engines.

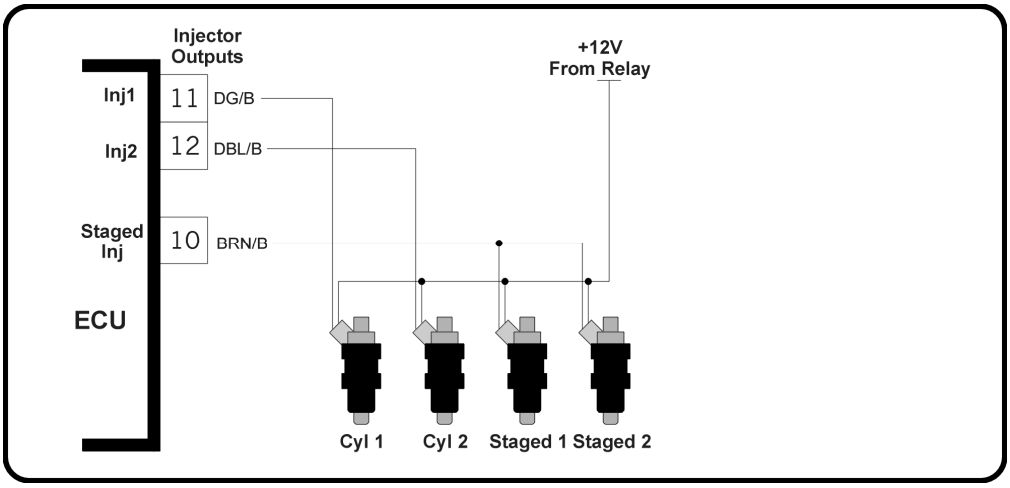
The minimum impedance of each Injector Output is 1.2 Ohms.



5.4.3.2 2 Cylinder Injector Configuration

2 Cylinder Engines can use 1 Injector per cylinder, plus Staged Injector(s).

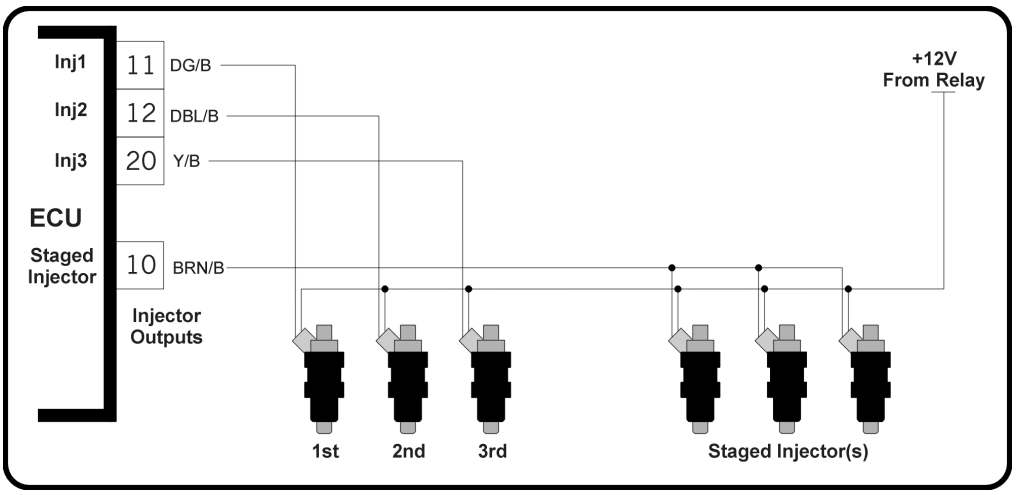
The minimum impedance of each Injector Output is 1.2 Ohms.



5.4.3.3 3 Cylinder Injector Configuration

3 Cylinder Engines can use 1 Injector per cylinder, plus Staged Injector(s).

The minimum impedance of each Injector Output is 1.2 Ohms.

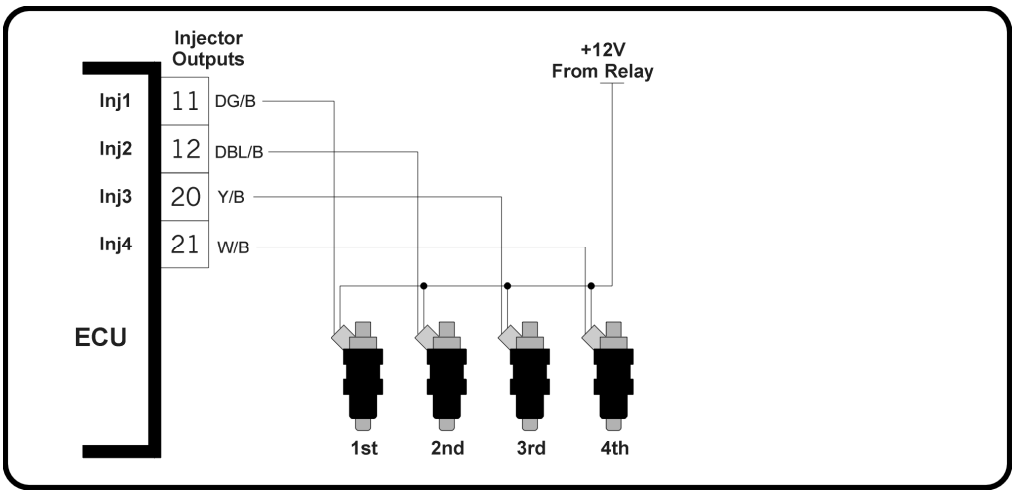


5.4.3.4 4 Cylinder Injector Configuration

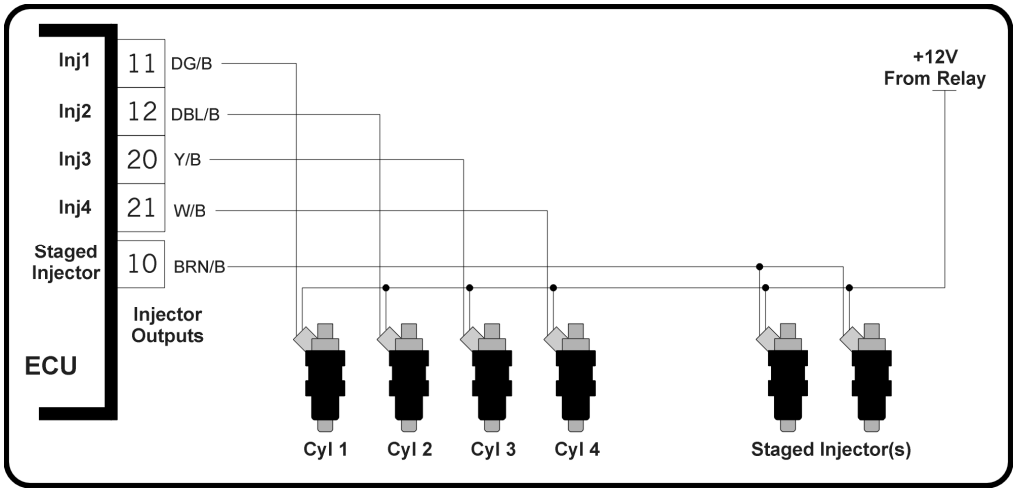
There are two combinations of 4 Cylinder Injector Wiring. The first is for standard “1 injector per cylinder”, the second is to add staged injectors.

The minimum impedance of each Injector Output is 1.2 Ohms.

You can configure the ECU for Sequential or Banked operation using this wiring configuration.



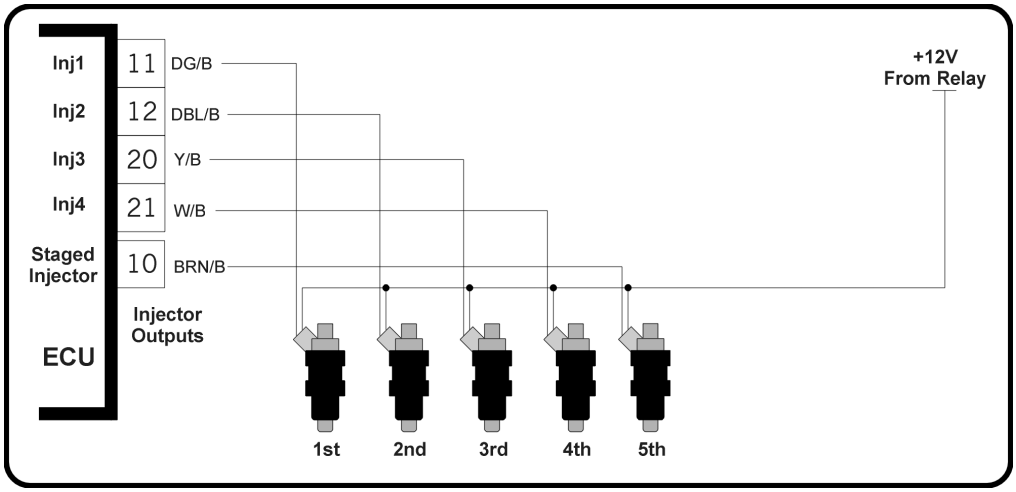
You can have almost any number of Staged Injectors, as long as the minimum total impedance of the injectors on any of the Staged Injector Outputs is 1.2 Ohms.



You can configure the ECU for Sequential or Banked operation using this wiring configuration.

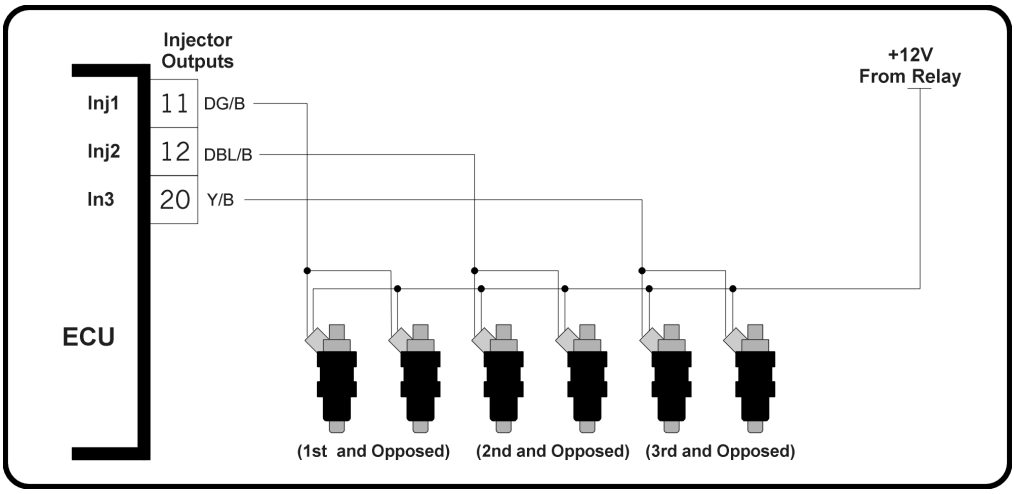
5.4.3.5 5 Cylinder Injector Configuration

5 Cylinder Engines use 5 individual injectors. When you use a Wolf3D Version 4, you can use the 4 Primary Injector outputs for Cylinders 1 – 4, and the Staged Injector output for the 5th Cylinder. The Staged Injector Output uses the same Trims as Injector 1 Output.



5.4.3.6 6 Cylinder Injector Configuration

There are several combinations of 6 Cylinder Injector Wiring. The first is for standard “1 injector per cylinder”, the second is to add staged injectors.

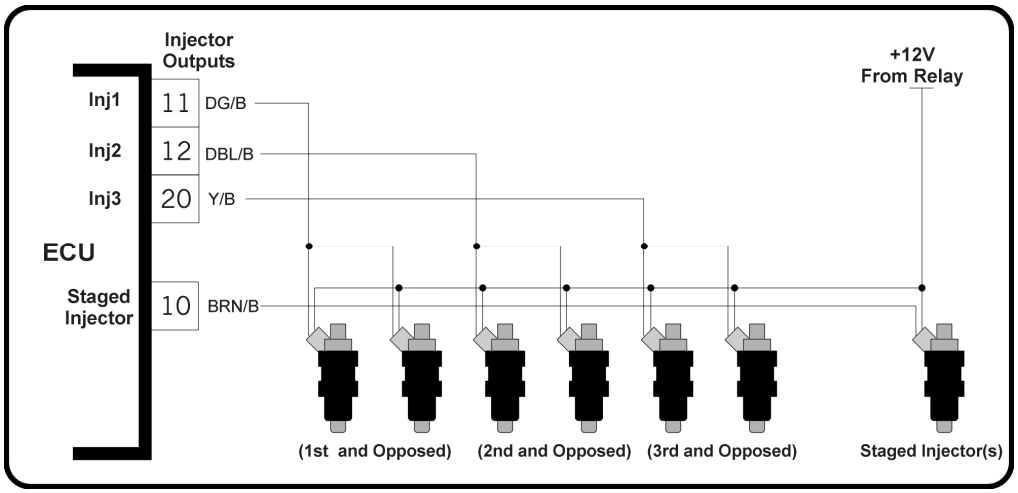


The minimum impedance of each Injector Output is 1.2 Ohms.

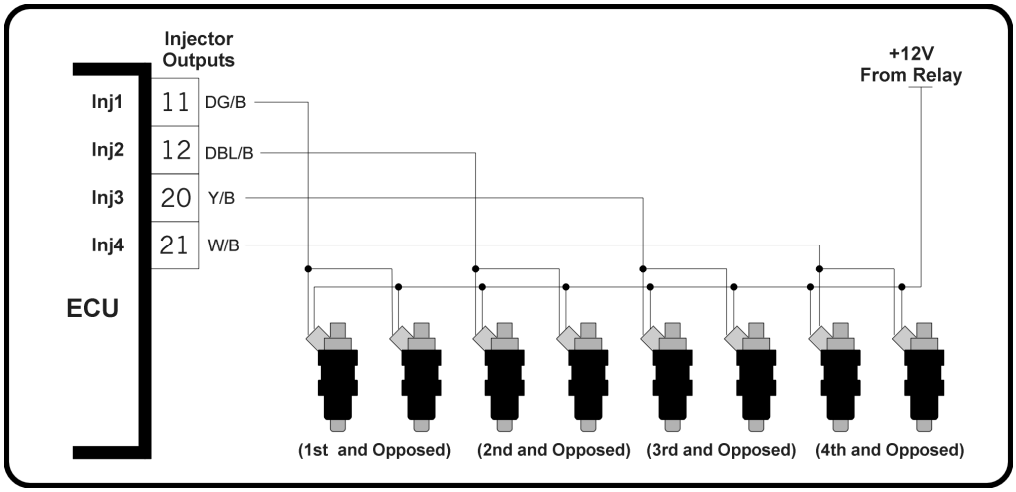
You can configure the ECU for Sequentially Banked operation using 3 of the Injector Outputs for this wiring configuration.

1 Injector per cylinder plus staged injection. The minimum impedance of each injector on any of the Primary Injector Outputs is 1.2 Ohms.

You can have almost any number of Staged Injectors as long as the minimum total impedance of the injectors on any of the Staged Injector Outputs is 1.2 Ohms.



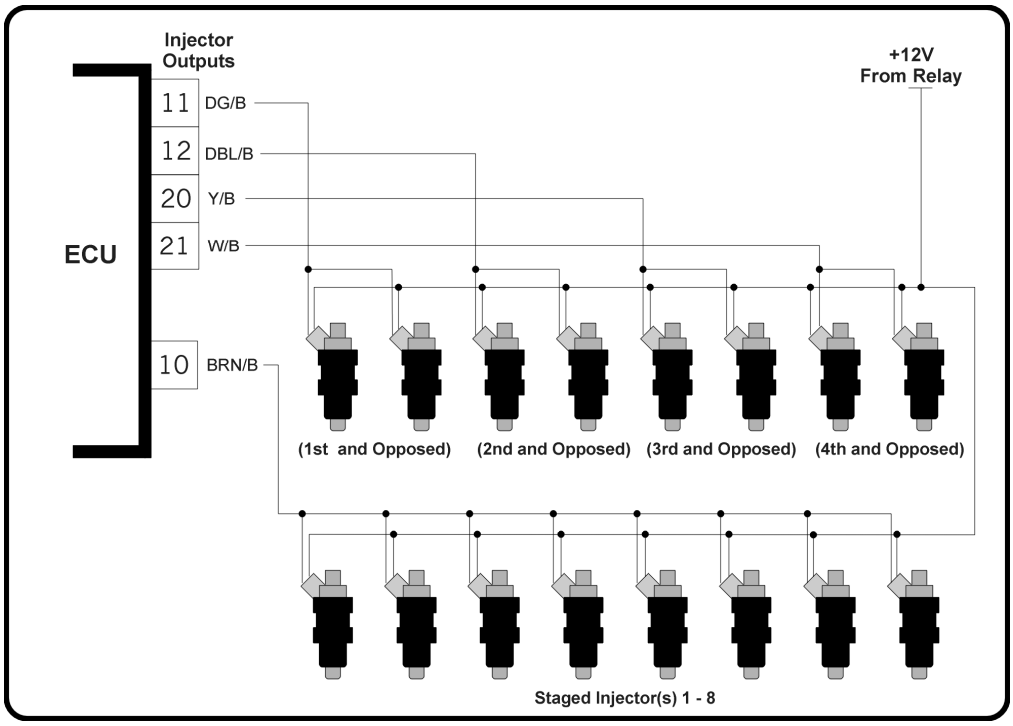
5.4.3.7 8 Cylinder Injector Configuration



The most common injector configuration for an 8 cylinder engine is to have 1 Injector per cylinder. The minimum impedance of each injector is 1.2 Ohms.

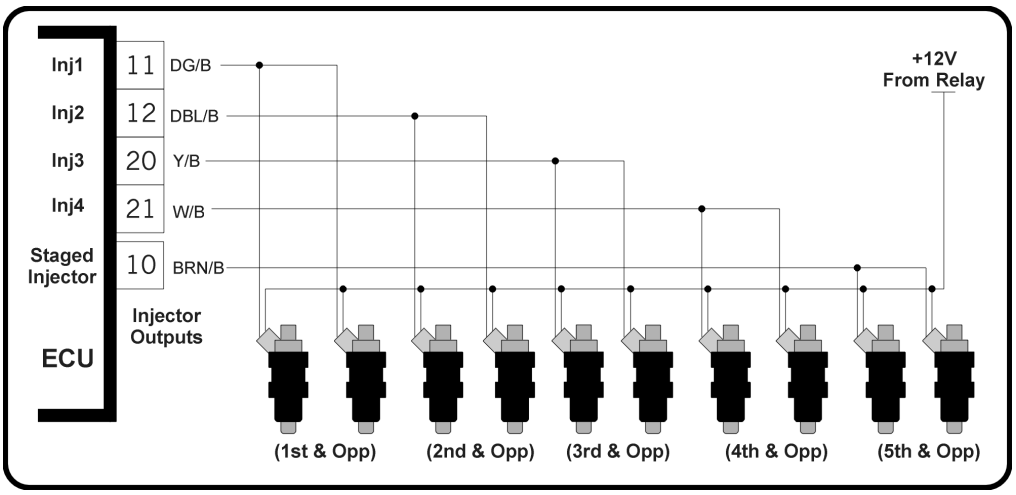
You can configure the ECU for Sequentially Banked operation using 4 of the Primary Injection Outputs for this wiring configuration.

For 8 cylinder engines with a very high power output, you can use 1 Injector per cylinder plus staged



injection. The minimum impedance of each injector on any of the Primary Injector Outputs is 1.2 Ohms. You can have almost any number of Staged Injectors as long as the minimum total impedance of the injectors on any of the Staged Injector Outputs is 1.2 Ohms.\

5.4.3.8 10 Cylinder Injector Configuration

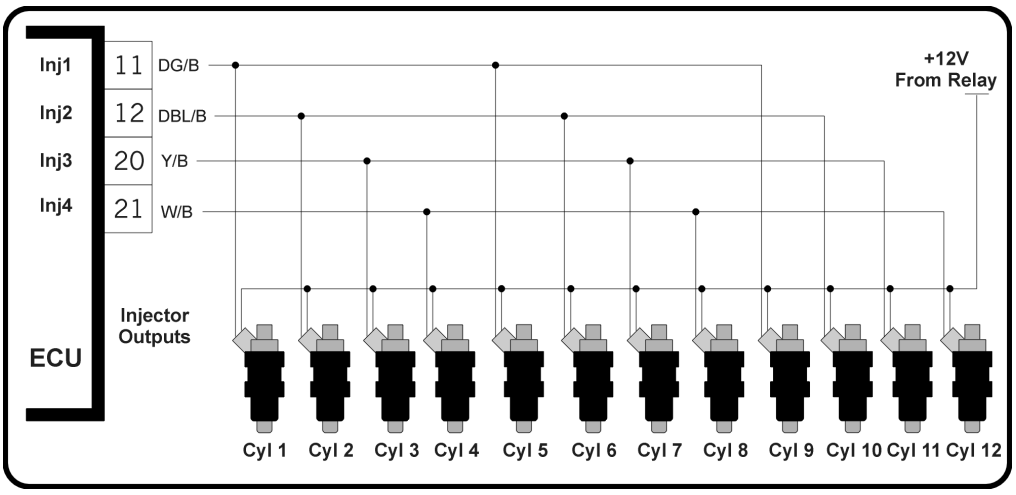


Each Injector Output has 2 injectors in parallel connected to it. Therefore each injector must be a minimum on 2.4 Ohms.

Since you are using all 5 Injector Outputs, including the Staged Injector Output, for the primary injectors, there is not staged injection available in this configuration.

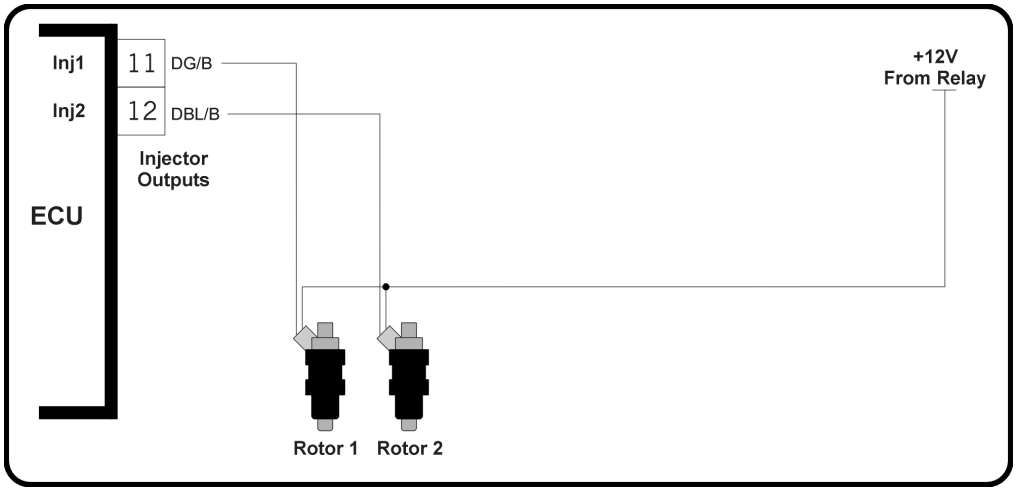
5.4.3.9 12 Cylinder Injector Configuration

Each Injector Output has 3 injectors in parallel connected to it. Therefore each injector must be a minimum of 3.6 Ohms.

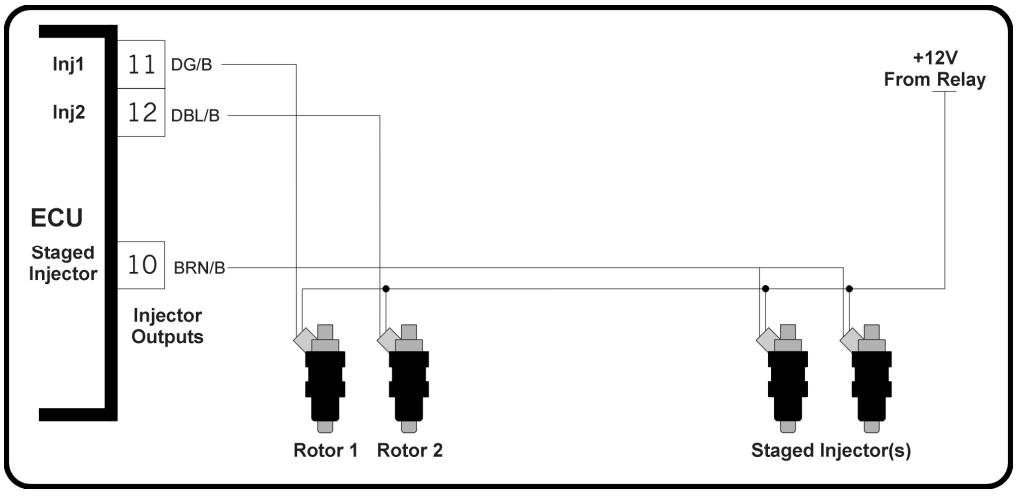


5.4.3.10 2 Rotor Injector Configuration

Some Rotary Engines have places for only 2 injectors.



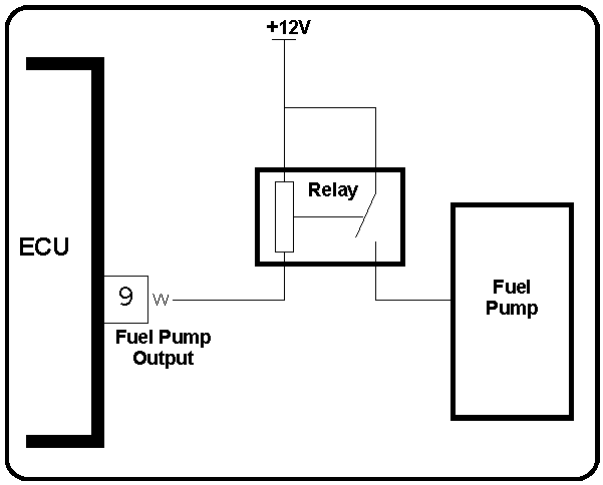
High output Rotary Engines require 2 Primary Injectors and 2 Staged Injectors.



5.5 Fuel Pump

The Fuel Pump Output operates under 2 conditions:

- ECU power-up
- Engine rotating



When the Wolf3D Version 4 turns on the Fuel Pump, the output pin pulls to ground. This output pin must be wired to a relay, that then switches power to the fuel pump.

The Fuel Pump Output is current limited to avoid any harm to the ECU, even if the output is connected directly to +12V.

Use a relay that is “Normally Open”.

EFI Fuel Pumps use a fair amount of electric current. You must use wire of large enough size to ensure there is no voltage drop by the time the electricity gets to the Fuel Pump. The Ground wire from the Fuel Pump to the Chassis Ground must be of equal size.

Use wire that is 4mm in diameter, or 1.25mm^2 .

Description	Pin Allocation	Wire Colour
Fuel Pump Output	9	White

5.5.1 Injector Care

It is very important to keep injectors in very good and clean condition. If the injectors have been sitting around for more than a few weeks, it is highly recommended that you have them cleaned by a professional injector cleaning company. They must be able to show you the flow of each injector.

All injectors to be used on an engine should flow within 5% of each other. If the injector flow varies too much from one injector to the next, the engine have poor idle quality and the engine will make less power than its maximum available power.

6 Pre-Start System Checks

Before you try to start the engine for the first time, there are a series of checks that you must carry out. These checks are very important. If you miss any of these checks, engine or car damage may result. These checks also get you on the road far more quickly than if you were to just try to get the engine running without going through these checks.

These checks can be broken down into 2 major areas:

1. Power-up Checks
2. Engine Cranking Ignition System Checks

6.1 Power-up Wiring Checks

Power-up Wiring Checks are very important, as they make you go through your installation point by point making sure that each input and output is wired to the correct sensor and correct output system.

As you go through the Check List, use the Tick boxes to check your progress.

Tick	Items to Check
	Low Pressure Fuel Pump Mounting Bracket (if applicable)
	Low Pressure Fuel Filter Mounting Bracket (if applicable)
	EFI Fuel Pump Mounting Bracket (if applicable)
	EFI Fuel Filter Mounting Bracket
	Surge Tank Mounting Bracket (if applicable)
	Low pressure Fuel Line from Surge Tank to EFI Fuel Pump
	High pressure EFI Fuel Line from EFI Fuel Pump to EFI Fuel Filter
	High pressure EFI Fuel Line from the EFI Fuel Filter to the Fuel Rail
	Fitting or Fuel Line between Fuel Rail and Fuel Pressure Regulator
	Vacuum Line between the Fuel Pressure Regulator and the Intake Manifold Pressure (if applicable)
	Return Line between the Fuel Pressure Regulator and the Surge Tank or Fuel Tank.
	All fittings on Surge Tank (if applicable)
	All fittings on Fuel Tank

6.2 Engine Cranking Checks

Engine Cranking Input Trigger Checks are used to ensure correct operation of various inputs and outputs that occur under engine running conditions.

Before going through the Engine Cranking Checks, disable the Fuel and Ignition System so the engine will not try to start. Do this by disconnecting the fuel pump relay, and the ignition system relay.

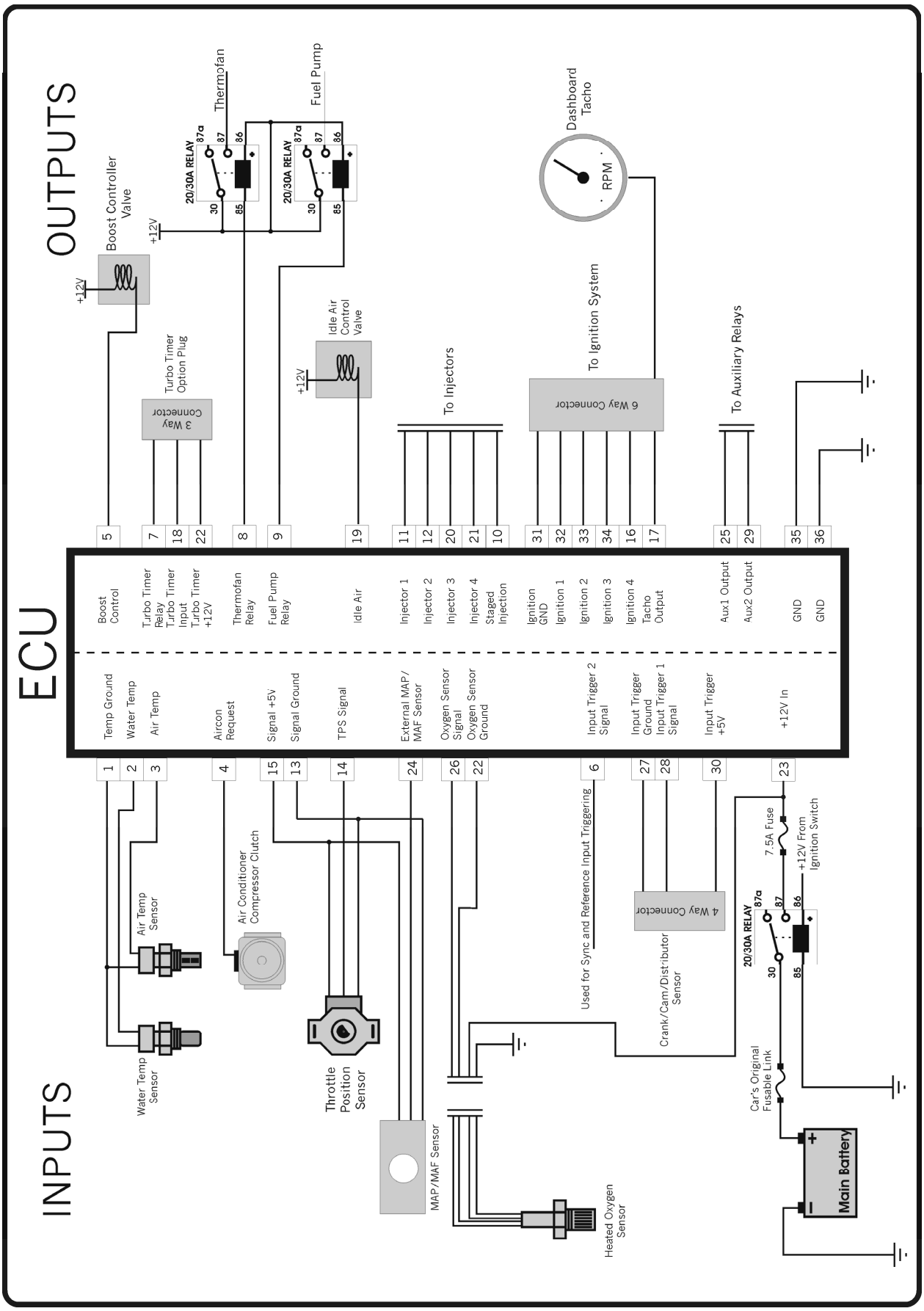
As you go through the Check List, use the Tick boxes to check your progress.

Tick	Items to Check
	What is the Battery Voltage with the ignition switch turned on (V) If the Hand Controller shows less than 13V with the ignition switch turned on, add a booster battery before continuing
	What is the Battery Voltage during engine cranking (V) If the Hand Controller shows less than 11V while cranking, add a booster battery before continuing
	Does the Input trigger LED flash while cranking
	What RPM is the engine cranking at (RPM) If the RPM is less than 100 RPM, add a booster battery before continuing
	Does the Input Trigger Error block go out and stay out while cranking?
	Do the Injector LED's flash?
	Do the Ignition Outputs flash?
	Reconnect the Ignition System relay and crank the engine
	When cranking, are you getting spark at the sparkplugs?
	Connect a timing light to the high tension lead of cylinder number 1 and crank the engine
	Does the timing on the Timing Light equal the timing on the Hand Controller?
	Reconnect the Fuel System relay and crank the engine
	Is the fuel pressure correct?

If you find all of the above conditions are met, it is time to start the engine for the first time.

Ensure that you have a well charged battery. You want to have plenty of battery capacity for the first time you want to start the engine to have high cranking speed. This is most important on large capacity engines, and engine that have just been rebuilt.

7 Wiring Diagram



8 Pinouts

Wolf3D V4.0 Pinouts

Pin ID Number	Wire Colour	Wire Type	Pin Description
1	Dark Blue/Red	0.5mm2 – 7/0.32	TEMP GND
2	White/Dark Blue	0.5mm2 – 7/0.32	WATER TEMP
3	Yellow/Dark Blue	0.5mm2 – 7/0.32	AIR TEMP
4	Violet/Yellow	0.5mm2 – 7/0.32	AIRCON REQUEST
5	Red/White	0.85mm2 – 16/0.26	BOOST CONTROL
6	Yellow/White	0.85mm2 – 16/0.26	TRIG 2
7	Yellow	0.5mm2 – 7/0.32	TURBO TIMER RELAY
8	Dark Green/White	0.85mm2 – 16/0.26	FAN RELAY
9	White	0.85mm2 – 16/0.26	FUEL RELAY
10	Brown/Black	0.85mm2 – 16/0.26	STAGED INJ
11	Dark Green/Black	0.85mm2 – 16/0.26	INJECTOR BANK 1
12	Dark Blue/Black	0.85mm2 – 16/0.26	INJECTOR BANK 2
13	Black	0.85mm2 – 7/0.32	SIGNAL GND
14	Dark Green/Dark Blue	0.5mm2 – 7/0.32	TPOS SIGNAL
15	Red/Dark Blue	0.5mm2 – 7/0.32	TPOS +5V
16	Dark Green	6 core shielded	IGNITION 4
17	Violet	6 core shielded	TACH OUTPUT
18	White	0.5mm2 – 7/0.32	TURBO TIMER INPUT
19	Gray/Tan	0.85mm2 – 16/0.26	IDLE AIR
20	Yellow/Black	0.85mm2 – 16/0.26	INJECTOR BANK 3
21	White/Black	0.85mm2 – 16/0.26	INJECTOR BANK 4
22	Green/Blue	0.85mm2 – 16/0.26	WIDEBAND OXY GROUND
23	Red/White	1.25mm2 – 16/0.32	+12V IN
24	Dark Blue	0.5mm2 – 7/0.32	EXTERNAL MAP SENSOR
25	Tan/Black	0.85mm2 – 16/0.26	AUX 1 INPUT/OUTPUT
26	Brown	0.5mm2 – 7/0.32	OXYGEN SIGNAL
27	Blue/Green	4 core shielded	TRIGGER GND
28	Brown/White	4 core shielded	TRIGGER IN 1
29	Orange/Dark Blue	0.85mm2 – 16/0.26	AUX 2 INPUT OUTPUT
30	Red/Yellow	4 core shielded	TRIGGER +5V
31	Blue/Shield	6 core shielded	IGNITION GND
32	Red	6 core shielded	IGNITION 1
33	Yellow	6 core shielded	IGNITION 2
34	Grey	6 core shielded	IGNITION 3
35	Black/White	1.25mm2 – 16/0.32	GND
36	Black/White	1.25mm2 – 16/0.32	GND

Wolf3D V3.1 and Earlier Vs V4.0 Pin Compatibility

Pin No.	Version 3.1 and Earlier Pin Description	Compatibility	Version 4 Pin Description
1	TEMP GND	100%	TEMP GND
2	WATER TEMP	100%	WATER TEMP
3	AIR TEMP	100%	AIR TEMP
4	AIRCON REQUEST/SWITCH	Early versions used this for Map Switching or Aircon Request, Version 4 uses this pin for Aircon Request only.	AIRCON REQUEST
5	AUX OUTPUT	Early Versions used this pin for a regular Auxiliary Output. Version 4 uses this pin for Dedicated Boost Control	BOOST CONTROL
6	COIL NEG	Not Compatible	TRIG 2
7	TURBO TIMER RELAY	100%	TURBO TIMER RELAY
8	FAN RELAY	100%	FAN RELAY
9	FUEL RELAY	100%	FUEL RELAY
10	STAGED INJ	100%	STAGED INJ
11	INJECTOR BANK 1A	100%	INJECTOR BANK 1
12	INJECTOR BANK 1B	100%	INJECTOR BANK 2
13	TPOS GND	100%	SIGNAL GND
14	TPOS SIGNAL	100%	TPOS SIGNAL
15	TPOS +5V	100%	SIGNAL +5V
16	IGNITION 4	100%	IGNITION 4
17	TACH OUTPUT	100%	TACH OUTPUT
18	TURBO TIMER INPUT	100%	TURBO TIMER INPUT
19	+5V OUTPUT	Not Compatible – check with each versions manual when changing from one version to another	IDLE AIR
20	INJECTOR BANK 2A	100%	INJECTOR OUTPUT 3
21	INJECTOR BANK 2B	100%	INJECTOR OUTPUT 4
22	TURBO TIMER +12V	Not Compatible – Damage will occur if you plug a Wolf3D Version 4 with Wideband, into an older Loom	WIDEBAND O2 SIG GND
23	+12V IN	100%	+12V IN
24	+12V OUT	Do not swap from early to later versions without checking this pin – ECU damage may result	EXTERNAL MAP SENSOR
25	OXYGEN GND	No damage will occur if ECU's are swapped between early and later version.	AUX 1 INPUT/OUTPUT
26	OXYGEN SIGNAL	100%	OXYGEN SIGNAL
27	TRIGGER GND	100%	TRIGGER GND
28	TRIGGER IN 1	100%	TRIGGER IN 1
29	Trigger 2	Trigger 2 was never used in early ECU's. No damage will occur if ECU's are swapped between early and later version.	AUX 2 INPUT OUTPUT
30	TRIGGER +5V	100%	TRIGGER +5V
31	IGNITION GND	100%	IGNITION GND
32	IGNITION 1	100%	IGNITION 1
33	IGNITION 2	100%	IGNITION 2
34	IGNITION 3	100%	IGNITION 3
35	GND	100%	GND
36	GND	100%	GND

9 Glossary of Terms

Anti-Surge Tank – A small fuel tank that is designed to eliminate any air bubbles in the fuel system before they get to the fuel injectors.

ATDC – After Top Dead Center

BTDC – Before Top Dead Center

Diode – An electric one-way valve. A Diode will only let current flow through it in one direction. Each Diode has a band around one end, this band shows the direction of current flow.

Dummy Load – A resistive load used to balance electrical systems.

ECU – Engine Control Unit

EFI – Electronic Fuel Injection

GND – Electrical Ground reference for all voltages. Ground connections are the most important when wiring in an ECU.

Impedance – Resistance of an electric winding.

LED – Light Emitting Diode. A light source, which is used for ECU diagnostics.

OEM – Original Equipment Manufacturer. Companies such as Ford, Mazda and GM are OEM companies. They manufacture the equipment in the first instance.

Potentiometer – A variable resistor often used as a TPS or for External Trim functions of the Wolf3D.

Solenoid – An electric winding around a magnet that is used to control fuel or airflow when an electric current is passed through the wires.

Surge Tank – Small Fuel Tank designed to stop air bubbles from entering the fuel lines and the fuel injectors.

TDC – Top Dead Center

TPS – Throttle Position Sensor

Wideband – There are two types of Oxygen Sensors, Narrow Band and Wideband (Bosch LSM- 11). Wideband Sensors are used for monitoring the engine Air : Fuel Ratio when tuning.