Glossary

Sequential Fuel Injection

Sequential means that each injector for each cylinder is triggered only one time during the engine's cycle. Typically the injector is triggered only during the intake stroke. True sequential injection requires the ECU to know not only where top dead center is, but also which half of the cycle the engine is on. TDC on a 4 stroke occurs 2 times during the cycle, once on compression and once on exhaust. MoTeC references all timing events that occur within the ECU, to Top Dead Center Compression. This generally requires an input on the engine's camshaft to provide the ECU with a SYNC signal. Once the ECU is synched, injection timing can be optimized to provide the most efficient mixing of fuel and air into the cylinder. Control of injection timing can lead to increases in midrange torque while decreasing emissions and fuel consumption.

Semi-Sequential Fuel Injection

Semi-Sequential means that 2 or more cylinder's injectors are triggered at the same time, but only 1 time during the engine's cycle. This requires the ECU to be synched with the engine's cycle. Typically injection timing is retarded from the optimum timing point for full sequential by an angle which is equal to 1/2 the angle between 2 cylinders in crankshaft degrees. On a V8 Chevrolet, the injectors for cylinders 1 and 8 would be triggered at the same time. They would be triggered 45 degrees late for cylinder number 1 and 45 degrees early for cylinder number 8. Degrees between 1 and 8 = 90 ; 1/2 of 90 = 45. Semi-sequential allows optimization of injection timing which typically leads to increases in midrange torque and a reduction in fuel consumption for equivalent power compared which Batch fire.

Injection Timing

With a synced engine which uses 1 injector in each intake manifold runner, it is possible to phase the firing of the injector so that it only sprays during the intake stroke. This allows you to introduce fuel into the intake stream precisely at the time when the airflow into the cylinder is the greatest providing the best possible atomization and the highest efficiency. MoTeC offers a user definable 2 or 3 dimensional Injection Timing adjustment table so that you can accurately match any engine's injection timing demands. Tuners can select either beginning or end of injection on which to base the timing table. This allows the tuner the ultimate in adjustability to suit any engine combination. With the M4 and M48 ECU's Injection timing is adjustable in 5 degree increments while the M400/600/800 Series offer .1 degree resolution making them suitable for Gasoline or Diesel Direct Injection.

Batch Fire

Batch fire means that 2 or more injectors are triggered at the same time once every crankshaft revolution. If the ECU is synched with the engine's cycle, the injection timing can only be half optimized as fuel is injected both on the intake stroke and on the power stroke. Companion cylinders are paired in batch fire mode similar to wasted spark ignition modes. The advantage of batch firing is that the ECU needs only to know where TDC is. This means that a sync on the cam is not required. The disadvantage to batch firing is that the Injector Dead Time is doubled for the engine's cycle. This leads to a decrease in fuel flow and typically requires a larger, less efficient injector to be used to make up for the loss of flow. On High Horsepower applications this means the idle quality will suffer tremendously.

Injector Dead Time

Injector dead time refers to the latency of the injector in producing maximum flow rate. All injectors require a certain amount of time to open completely and produce maximum flow. The amount of time is dependant on several variables including; fuel pressure, battery voltage and physical characteristics of the injectors themselves. Typically higher fuel pressure or lower battery voltage tends to increase the dead time. This leads to a reduction in fuel flow in to the engine and as a result influences the engine's state of tune. Luckily MoTeC allows the user to define an injector Dead Time table if the values are known, or use a standard compensation which is known for a number of injectors. The ECU automatically adjusts the values as the battery voltage changes to ensure that the fuel curve remains constant. If a fuel pressure input is used on the system, MoTeC can compensate for variations in fuel pressure to achieve a consistent fueling even with varying fuel pressures.

4 Wire Wide Band Lambda Sensor

This technology takes advantage of the fact that a 4 Wire Wide Band Lambda sensor's voltage output is based on not only the oxygen differential between the exhaust pipe and atmosphere, but also is dependant on the temperature of the sensor itself. Sensor impedance varies with temperature, so a MoTeC ECU measures not only Wide Band Lambda Voltage, but also the sensor impedance. It is not possible to properly display lambdas without monitoring the sensor temperature. Systems which do not use at least a 4 wire sensor typically have errors in displayed lambda as high as 8%!

5 Wire Wide Band Lambda Sensor

This newer technology is used to determine the air fuel ratio of an engine by measuring lambda sensor output and measuring the current required to hold the sensor voltage output constant. An oxygen sensor produces voltage and a small amount of current as oxygen atoms pass across its substrate from high concentration to low concentration. The greater the flow of oxygen, the greater the voltage produced. This is the case when a rich mixture is encountered. Conversely, when current is applied to an oxygen sensor, oxygen atoms are moved from a low concentration to a high concentration or vice versa depending on the polarity of the current applied. The MoTeC M400/600/800/880 ECU's are capable of measuring this type of sensor input which offers increased speed and accuracy over the older technology 4 wire sensors. M4 and M48 ECU's can leverage the 5 wire technology by connecting a MoTeC PLM, which has a definable analog voltage output, to the Lambda input on the ECU.

What is Lambda?

Lambda describes an equivalence value in percentage of the chemically correct air-to-fuel ratio for any type of fuel. If the air fuel ratio measured in the exhaust pipe of an engine is at the chemically correct (stoichiometric) ratio of air-to-fuel, lambda is equal to 1.0. In the case of gasoline, lambda 1.0 is equivalent to 14.7:1 air-to-fuel. Lambdas less than 1.0 indicate the engine is running richer than stoichiometric, while lambdas greater than 1.0 indicate a lean mixture. If we measure a lambda value of 1.06 and we want a lambda value of .95, we simply increase the fuel delivered to the engine (pulsewidth) by 11 percent. This will place us exactly at .95 lambda. By using the Lambda Was or the Quick Lambda functions a tuner can quickly shape the fuel table to match the engine's exact requirements. In addition, the W Lambda function copies the Quick Lambda value to the sites immediately to the right and up above to help keep the fuel table variance from one site to another at a minimum.

Bosch LSU and NTK UEGO Sensors

Both the MoTeC M400/600/800/880 and the MoTeC PLM are capable of operating with either the NTK UEGO or the Bosch LSU-4 5 wire wide band sensors. Of the two, the NTK is most accurate. It is a true laboratory grade sensor. Its accuracy has been found to be about 1.5% better than that of the Bosch LSU. Additionally the NTK has a better response time than does the LSU again about 1.5%. The NTK is the benchmark against which the LSU is measured. The advantage of the LSU sensor is its lower price compared to the NTK. If you are doing very precise and accurate laboratory type testing, the NTK is the sensor for you. Both sensors have a life expectancy of 500 hours on unleaded fuels and that number is diminished to 50 hours using leaded fuels. Lambda Sensors are very similar to spark plugs with respect to their estimated life expectancy. Spark Plugs are designed to last 40,000 miles under optimum circumstances but they can be damaged in less than 1 mile by misuse. A lambda sensor can be thought of the same way. Misuse by overly rich mixtures, high temperatures, overtightening or dropping can have a very negative effect on lambda sensor life. Like spark plugs, lambda sensors cannot be returned under warranty.

Quick Lambda and Lambda Was

A MoTeC ECU, allows the user to define a lambda goal table based on load and rpm. The Quick Lambda function in the software allows a tuner to quickly adjust the values in the fuel control table to achieve the goal lambda, based on the lambda reported by the sensor. If the reported lambda is .98 and the goal is .93, the ECU automatically jumps to the current load site, and multiplies the value in the site by 1.05. The next time the engine runs in that site, the lambda will be .93. Similarly, Lambda Was allows a user to locate a load and rpm site in the main fuel table and enter a recorded lambda measurement from a data log. The ECU multiplies the load site value by the difference between entered lambda and the goal lambda value so that the engine will achieve the goal lambda the next time it runs on that load site. This makes tuning much faster and easier than calculating the required enrichment based on an air fuel ratio number. Of course you can manually do multiplication, division, addition and or subtraction on any site or a number of sites with only a few keystrokes, and the overall trim function allows you to trim the entire fuel or ignition table up or down based on percentage.

CDI-8 Ignition

Capacitive Discharge Ignition has been used in racing and in some automobiles for a number of years. MoTeC offers one of the industry's most advanced capacitive discharge ignition systems available. The CDI-8 is an 8 channel CD Ignition which can either run in stand alone mode (meaning it does not require an ECU to run it) or in slave mode. In slave mode, the CDI-8 receives an encoded signal from a MoTeC ECU which tells it which coil output to fire. In this mode, a CDI-8 can deliver a full energy spark at up to 1.1KHz which is enough to keep up with an 8 cylinder engine turning 16,000 rpm!

MoTeC Software

Always free from www.motec.com New software upgrades will allow additional features for your ECU. Since each ECU is produced with all of the same hardware, there will never be an issue of a feature not working with an older ECU. New features will always work with every ECU.

Security

MoTeC offers its customers the option of securing their tuning file through two methods. The first is a simple password protection which can be set on the ECU so that others are not able to make changes to the tuning file nor can they send a new file to the ECU unless they have the password. The password can be reset as often as you like, and you may choose to turn the password off at anytime but you must know the password in order to perform these functions. Additionally, MoTeC allows the tuner to encrypt a file which is stored within the ECU. In this case, the file can only be sent to an ECU which has a matching password for the encrytped file. If file encryption is used, a tuner could send an encrypted file to a customer with a matching password, and the customer would be able to send the file to the ECU without knowing the password. The customer would still not be able to view or in anyway modify the file. Data downloads can always be retrieved whether or not a password is set on an ECU.

High/Low Injection Capability

On many types of racing engines, tuners may find improved efficiency by changing the physical location of the injector in relation to the intake valve. MoTeC allows the user to run 2 sets of injectors in the inlet path and switch from one to the other with a 3 dimensional table based on load and rpm. Typically this feature is used when an engine is making substantial amounts of horsepower but requires only small amounts of fuel at low speeds. In this case, the tuner can select 2 injectors of differing flow rates, one for low speed operation, the other for high speed/power operation. MoTeC allows you to define the flow differential between the 2 injectors, so that the proper amount of fuel can be delivered out of each injector. Another way to use the MoTeC High/Low capability, is to use 2 injectors of equal flow rate, but located at different points in the inlet path. In this manner, fuel injection location can be varied at certain points in the rpm band to provide the highest efficiency. Of course MoTeC allows you to enrich or enlean the engine at the transition from 1 set of injectors to the other to provide seamless operation.

Crank Index Position

The CRank index Position is perhaps the most important timing value in the ECU. The CRiP tells the ECU where the engine is in relation to TDC Cylinder #1. The CRiP is defined as the distance in crankshaft degrees, between the reference tooth when it is aligned with the crankshaft position sensor, and Top Dead Center Compression Number 1. For example, if the reference tooth is aligned with the crankshaft sensor when the crankshaft is 55 degrees before TDC Compression Number 1, then the CRiP is 55. An easy way to determine the CRiP before startup is to rotate the crankshaft in the direction of rotation until the reference tooth is aligned with the crankshaft position sensor. Then measure the number of degrees, required to turn the crankshaft in the direction of rotation until the number 1 cylinder is at Top Dead Center of the Compression stroke. Once you determine this value, you may start the engine and enter the CRiP set screen under the Ignition menu. Use a non dial-back timing light to check the CRiP. The timing advance displayed in the CRiP set screen should match the measured value using the timing light. If they do not match, move the CRiP value until the timing does match.

Reference Tooth

The definition of the Reference Tooth depends on the type of Ref/Sync mode being used. If using missing or extra tooth type modes, the reference tooth is defined as the tooth which occurs directly following the missing or extra tooth or teeth. If using 1 tooth per TDC or Multiple tooth mode with a sync input, the reference tooth is defined as the tooth which occurs directly following the sync input.