



**THUNDERMAX**  
*EFI made simple.*

## **IGNITION TIMING & ADJUSTMENTS**

**SmartLink IV Tuning Manual Excerpt**  
Pages 135-143  
SOFTWARE Version 2008.1.14 For  
ThunderMax High Resolution ECM  
For 2001-2009 Delphi®-Based Air Cooled Motorcycles  
(Except 2008-09 Touring Models)  
Manual V.20090528

The ThunderMax EFI controller is not legal for use or installation on motor vehicles operated on public highways in the State of California or other States where similar emission control laws may apply.

The user shall determine suitability of the product for his or her use. The user shall assume all risk and liability in violation of regulations and any incurred financial obligations due to vehicle inspections or emissions tests.

**Email Technical Questions to:**  
**[ProductSupport@ZippersPerformance.com](mailto:ProductSupport@ZippersPerformance.com)**  
**[www.Thunder-Max.com](http://www.Thunder-Max.com)**

## **IGNITION TIMING MAPS**

There are many variables associated with proper ignition timing; for this reason, it is impossible for the ThunderMax Base Maps to be a perfect match for every situation. The good thing is that the adjustability of the ThunderMax ECM allows the user to set the ignition timing for his / her individual motorcycle. The first thing in correcting a pinging issue is to identify the severity of the problem. Would you consider the pinging issue to be light to moderate, with an occasional occurrence, or do you have a severe pinging problem? Do you know at what RPM the pinging is occurring?

### **Severe Pinging:**

If you have a severe pinging problem, a change needs to be made immediately to your ThunderMax ECM. It is not recommended to continue operating the motorcycle if the pinging problem is severe, damage to the engine can occur if the issue is left unattended.

1.) The first thing to do with a severe pinging problem is to double check that the Base Map you're using is close enough for your application. Use the instructions on page 36 to determine if you have the closest Base Map to your application, following the "Key Elements" listed on page 37. If you find a closer Base Map, try using it before modifying anything.

2.) If you already have the closest Base Map for your engine combination, you should immediately begin retarding the timing on the "Timing vs. Engine Speed" map page, see page 139. Knowing an approximate RPM range of the pinging will help you correct the problem quickly. If you do know the RPM range of the problem, simply remove several degrees of timing in the area of the pinging in an attempt to minimize it. Repeat until the majority of the pinging has been eliminated from normal use. If you do not know an RPM range, start removing 1-2 degrees of spark timing across the operating range of the engine. Repeat until the pinging has been greatly reduced.

3.) Once you've removed enough timing to control most of the pinging, move to the next section titled "Light or Occasional Pinging." Now that you've gotten the ignition timing much closer and removed most of the pinging, the following section will help you determine what is causing the issue, and how to address it.

### **Light or Occasional Pinging:**

A light or occasional pinging problem can be caused by many variables, from the components used in the engine (cams, compression, exhaust system) to the overall motorcycle setup (passengers, trailers, cargo / gear, trike conversion kits). In addition to the motorcycle setup, the terrain you're traveling on greatly effects the loading of the engine, which is a variable in ignition timing and spark knock control. The ThunderMax ECM, unlike most of its competitors, gives the user complete control of the ignition timing for your engine. The key to solving spark knock is knowing the RPM that the

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pinging occurs at, and the AFR that the engine is achieving at that point. To aide in solving a light to moderate pinging problem, read the following 2 scenarios, and follow the instructions of the scenario that best describes your issue. The first scenario is a new ThunderMax installation with little to no ride time, or a change has been made to the engine or motorcycle (weight) on a good running ThunderMax installation. The second scenario is when pinging is only experienced while riding long distances, or on high mileage out of town trips.

### **1.) A new ThunderMax installation with little to no ride time or a change has been made to the engine or motorcycle (weight).**

If you've just installed the ThunderMax ECM, or have only ridden the motorcycle a few times prior to installing, the AutoTune module is still working on achieving the set AFR Targets. Continue riding the motorcycle to see if the situation improves. Several riding sessions, and a few hundred miles should be ridden before any major changes are made. Follow the "Accelerated AutoMap Procedure" found on page 114 for instructions on how to Read & Write your fuel offsets as the Base Map. The AutoTune module may solve the occasional pinging issue simply by achieving the proper AFR Target.

If an engine or chassis modification has been made to a known good running motorcycle, and pinging is a result, you may need to load a new Base Map, or modify the "Timing vs. Engine Speed" page. Camshafts, big bore kits, and compression changes can have a large effect on required ignition timing. If weight is added to the motorcycle, the loading of the engine changes dramatically. Trailers, passengers, heavy cargo, and trike conversion kits all change the overall vehicular weight, and will force you into different throttle positions for the same speed range.

View the AutoTune Points Analyzer for clues to the amount of offsets generated by the AutoTune module. If this is telling you to choose a new Base Map, see page 36 for instructions on Base Map Selection. Otherwise, proceed to page 139 for an explanation on how to modify the "Timing vs. Engine Speed" map page.

If the AutoTune Points Analyzer only leaves you with more questions, see page 104 for instructions on how to use the "Prepare and Send Module Data Email" function. This will send your map and offsets to the Product Support Team for review. In this situation, a new Base Map may be suggested, or a modified version of your current Base Map may be returned to you.

If you believe that you have the proper Base Map, you may begin modifying the "Timing vs. Engine Speed" map page, as described on page 139. If you know the RPM range of the pinging issue, start by removing several degrees of ignition timing from this area. If this is not fully removing the pinging, you may need to modify the AFR Targets in this same RPM range to fully remove the pinging.

To modify the AFR Targets at the RPM of the pinging, use the "AFR vs. TPS" pages, as described on page 144. Adding fuel to the areas of spark knock will help cool the combustion chamber, which will reduce the pinging. Adding fuel by itself is rarely the solution, but a combination of increased fuel and decreased ignition timing will yield the

best results. Try setting the AFR Override at 12:1 to see if the problem goes away (page 98). If it does, turn off the AFR Override and begin modifying the AFR vs. TPS Target Pages to 12:1 in the RPM range, and throttle position, of the pinging. Knowing where the pinging is occurring is always the key to eliminating it.

### **2.) Pinging is only experienced while riding long distances, or on high mileage out of town trips.**

Due to the regional differences in fuel blending, you may only be experiencing a spark knock situation due to a poorer quality of fuel than you're normally used to. In addition, if you're traveling with a passenger and / or gear, you have changed the weight of the vehicle enough to alter the loading of the engine. Terrain changes may amplify the problem if you're heavily loaded with gear, and now you're going uphill, which adds even more load on the engine. If you're on the road and have no way of linking to the ECM, when possible reduce the load to the engine and try a higher quality gasoline and / or a bottle of octane booster may help reduce the pinging.

### **SmartLink Timing Control Features:**

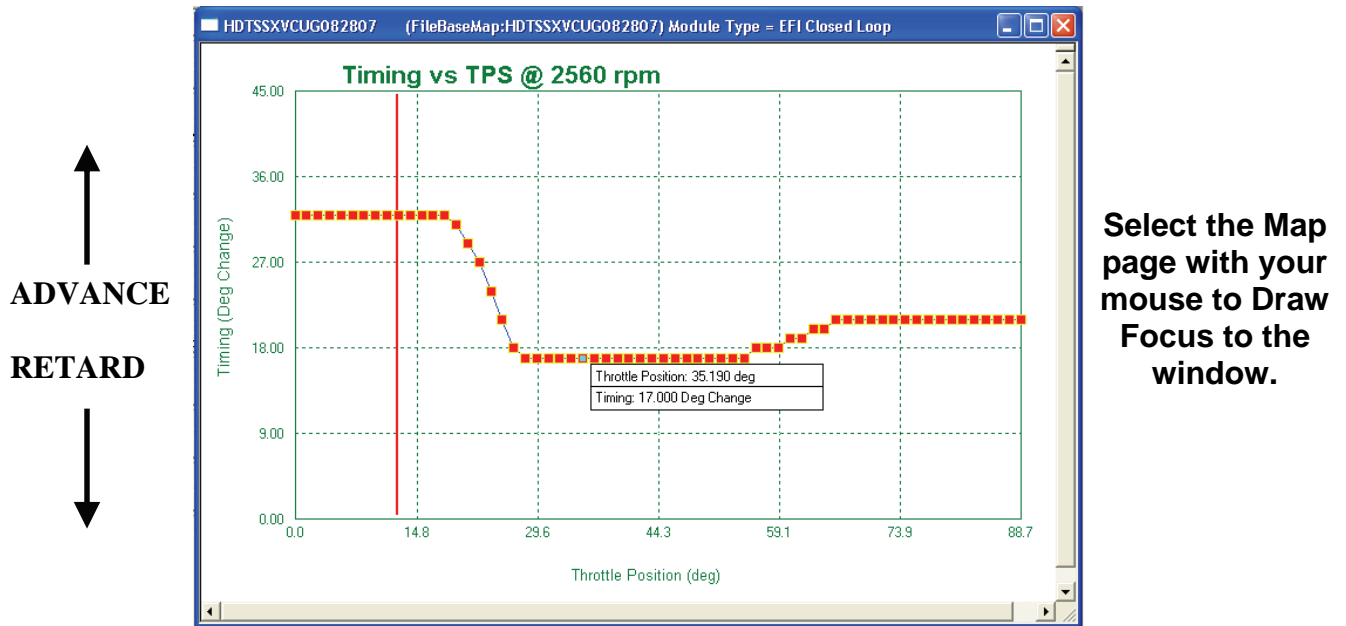
1.) **Full "Timing Curve" Map Pages** - A map page is available for every 256 RPM, showing the full ignition curve for each RPM, 32 pages total. These shapes were created on a load-cell dynamometer with the specific parts listed in the Base Map definitions. It is best that changes made to these pages are attempted last, after modifying the "Timing vs. Engine Speed" page, and only with the knowledge of the live AFRs. Significant alteration of these pages should be performed on a load-cell dyno by a trained technician.

2.) **Rear Cylinder Adjustment** – A page titled "Rear Timing vs. TPS" is now available, this page allows you to make fine adjustments on the Rear cylinder only to offset any situations where the rear cylinder requires a different timing. **Most cases will not require Rear cylinder adjustment**, only make changes to this page if you've validated that your rear cylinder requires a timing adjustment on a dynamometer. **No data = no adjustment.**

3.) **Timing vs. Engine Speed** – This composite timing map allows for a quick view of the overall timing scheme, and eases adjustment with an easier to understand map page. This page shows the wide open throttle curve; adjustments to this page move all 64 points on each particular RPM curve map page.

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## Timing vs TPS @ RPM; Full Timing Curve Map Pages:



The 32 Map pages that display the Timing vs. TPS @ RPM are now available to all users of SmartLink IV. These pages contain the complete timing curves used by the ThunderMax ECM. Remember that each page is a static RPM page, relating the Timing in degrees to the Throttle Position.

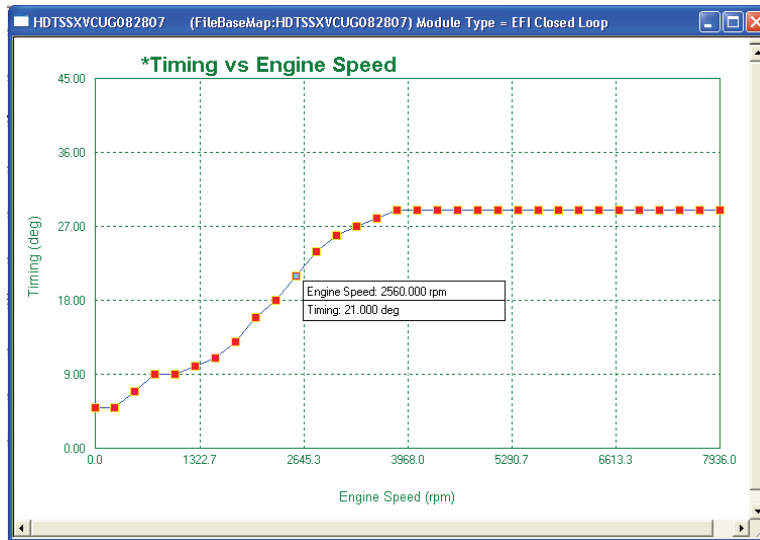
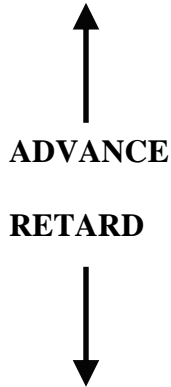


You can cause serious engine damage if the timing is set too aggressively. If timing changes are being tested on a road environment, great care must be taken in watching your surroundings and staying safe.

Since the Timing vs. TPS @ RPM map pages were developed at Zipper's on dynamometers using sophisticated equipment, it is impossible for Zipper's to help you customize each individual map page for every conceivable combination. If you only need a slight timing adjustment at a specific RPM, consider using the Timing vs. Engine Speed Map page, as described in the next section.

**Timing Vs Engine Speed Map Page:**

This map page is for making quick adjustments to the ignition timing map. It allows ignition timing adjustments in one-degree increments at every 256 RPM from the base setting of the installed map.



**Wide Open Throttle Timing Display**

**Each point change moves all 64 points on the corresponding Timing vs TPS @ Rpm Map Page.**

Each point in the **Timing vs. Engine Speed** map page allows the tuner to adjust the spark timing for a particular RPM range. Moving a tuning block on this page will move every point on the corresponding RPM map page. For example, if you adjust the 2560 RPM tuning block up one degree, ALL throttle position points on the 2560 RPM page will move up one block.

If the knock is slight at a particular RPM, you may be able to remedy the situation by removing 1-2 degrees of timing at the Timing vs. Engine Speed page at the specific RPM it occurs. If the knock is more pronounced you may need to remove additional timing at specific throttle positions on the Timing Vs TPS pages at the specific RPM value you want to adjust then road test to review the changes.

**Attempt to adjust the timing on this composite page before altering the curves on the Timing vs. TPS @ RPM map pages.**

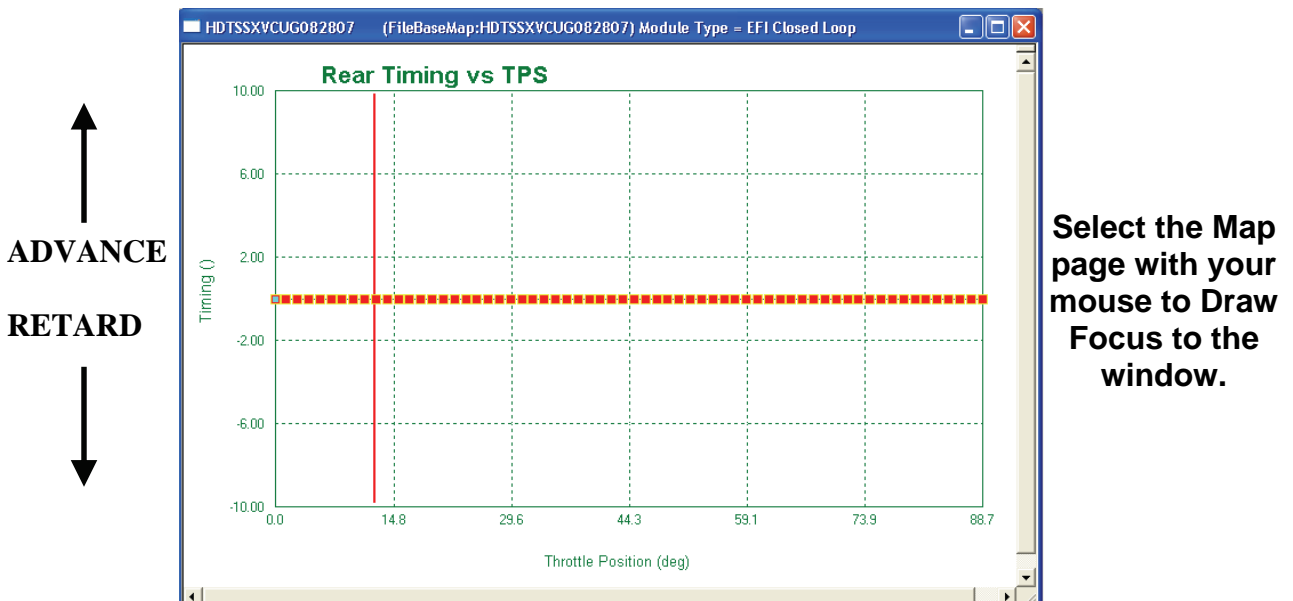
**NOTE:** Higher values of spark advance can improve response, efficiency, and power until you reach the point of detonation, which reduces power and can damage the engine.



**WARNING! BEWARE OF DETONATION!** Severe pre-ignition or detonation can cause severe engine damage. If spark knock is heard or detonation is found by reading your spark plugs, immediately stop testing and retard the ignition timing at that RPM to remedy the situation.

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## Rear Timing vs. TPS (Rear Cylinder Timing Correction):



The Rear Timing vs. TPS page was added to eliminate any oddities between the front and rear cylinder operation. The ThunderMax AutoTune system individually monitors and alters the fuel setting for each cylinder for optimum operation. Now you have the ability to individually adjust the rear cylinder's timing in comparison to the front cylinder as well. Due to the differences associated with the operation of the two cylinders, the rear cylinder adjustment allows you to modify the spark for optimum operating conditions.

Modifying the Rear Timing vs. TPS page does not alter the Timing vs. TPS @ RPM map pages. This page only offsets the output of the main spark curves, but does not affect the front cylinder timing at all.

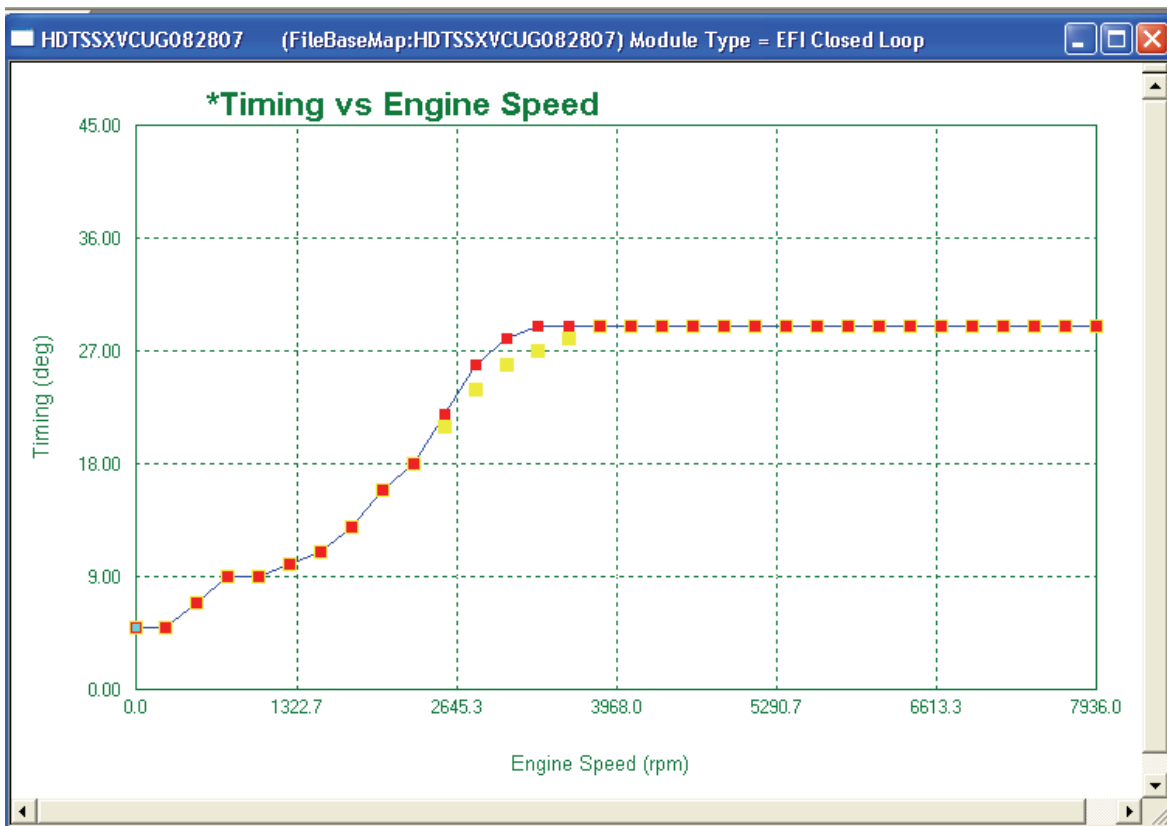
This page will always start as a straight line at 0% Timing Adjustment. Any adjustments made to this page are recorded as % Timing Adjustment by Throttle position.



**Most cases will not require Rear cylinder adjustment, only make changes to this page if you've validated that your rear cylinder requires a timing adjustment on a dynamometer. No data = no adjustment.**

## Smoothing the Blocks:

It is important to “smooth” the surrounding blocks to avoid abrupt changes in timing settings. The following figure shows a smooth spark curve adjustment change. Since the Timing vs. Engine Speed page has changed from a straight line showing the percentage of change to the generalized spark advance curve, it should be easier to smooth the blocks and see the changes that are being made to the Base Map timing curves. Remember you can always check each of the individual timing curves (Timing vs. TPS) map pages to see the effect that has occurred. If in doubt, test the new setup, record your findings, and make changes as needed.



## How to find Throttle Position of Detonation (Spark Knock or Pinging):

If you are attempting to tune with or without the benefit of a load control dynamometer, you may find the following suggestion helpful. Link to the module without starting the engine with the monitoring function enabled, open the Air/Fuel vs. TPS window and observe the red vertical bar indicating active throttle position. Twisting the throttle through its range will move this vertical bar. Using masking tape; wrap tape around the throttle grip, at the edge closest to the switch housing. Apply another piece of tape to the switch housing (base) alongside of the grip tape. Make a mark across both pieces of tape indicating the throttle position at idle. See the pictures on the next page for clarification.

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Using the vertical bar as a guide, make marks on the grip tape even with the base idle mark at  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$  and full throttle. When you can identify the location of the throttle position and the associated RPM during a drivability issue, you will find it very easy to pinpoint and make adjustments to the areas that need help. The following pictures show an example of how to use tape to tell an approximate TPS where the detonation is taking place.



**WARNING: ANY TUNING OPERATION INVOLVING ACTUAL OPERATION OF THE MOTORCYCLE ON PUBLIC STREETS OR HIGHWAYS IS DANGEROUS! FULL ATTENTION TO TRAFFIC CONDITIONS SHOULD ALWAYS BE YOUR FIRST FOCUS ANYTIME YOU ARE OPERATING A MOTORCYCLE ON PUBLIC ROADS. INATTENTION TO CONDITIONS CAN LEAD TO ACCIDENTS AND PERSONAL INJURY INCLUDING DEATH.**



Closed Throttle – Marked “0”



$\frac{3}{4}$  Throttle – Marked “3”

### Timing Troubleshooting:

Here are a few common scenarios that have been seen several times by Product Support. The first thing you need to do before you adjust the base map is to verify you have selected the correct map. Selecting a map with incorrect parameters is usually the source for spark knock problems. Take the time to verify the best possible base map has been selected for your application.

- 1.) If you have not experienced any spark knock or detonation problems, **but pinging develops after your last fuel stop**, do you need to adjust your timing? As long as spark knock has not been experienced before, continue operation of the motorcycle, and purchase fuel from a different source before making any changes to your map.

It is common for gasoline to be blended differently in different regions of the country. Touring riders will experience this much more so than riders that stay in one region of the country.

- 2.) If the gasoline has not made a difference in the operation of the motorcycle, check that your intake & exhaust seals are not leaking, your AutoTune module is turned on, as well as reading the spark plugs. If excessive oil is found on the plugs, you may have a head gasket leak. A head gasket leak can cause detonation by depleting the octane rating of the fuel, allowing a build up of gasoline in the combustion chamber, and igniting the rich mixture when the temperature reaches a high enough level to pre-ignite.