



**CAUTION: CAREFULLY READ INSTRUCTIONS BEFORE PROCEEDING. NOT LEGAL FOR SALE OR USE IN CALIFORNIA OR ON ANY POLLUTION CONTROLLED VEHICLES.**

## OVERVIEW

The TCS-1 is a versatile timing control system for race engines. It is a direct replacement for MSD P/N 8980 Timing Computer with many additional features.

- Preprogrammed with 20° advance curve between 1,000 and 3,000 RPM for V8 engines same as MSD P/N 8980.
- Magnetic pickup (distributor or crank trigger) and module trigger inputs.
- Module trigger output drives all CD systems including MSD 6 and MSD 7 series.
- USB interface and PC Link software allows programming advance features ranging from a simple RPM based advance curve to a 3D timing map with boost proportional retard (requires optional MAP sensor).
- Two general purpose input and one general purpose input/output terminals. Inputs can be programmed for multiple retard functions including driver adjustable retard. Output can be programmed for RPM window switch function.
- GPI inputs preprogrammed for 2°, 3°, and 4° retard functions (can be combined for a total 2-9°).
- Heavy duty industrial grade clamping terminal blocks allow easy and reliable hookup without soldering or crimping.
- Compact size: 3.3"L x 2.4"W x 1.1"H.
- USB interface to laptop PC (not required for basic operation). Powerful Windows software for programming controller functions including use on 4 and 6 cylinder engines.

## ADDITIONAL REQUIRED PARTS

For a driver adjustable timing retard or boost proportional retard, you will require the optional RTD-1 retard control P/N 102005. To connect a Delphi MAP sensor, you will have to fabricate a wiring harness with the appropriate mating connector or use our MAP sensor harness kit P/N 102006.

The parts bag supplied with the TCS-1 includes a magnetic pickup harness with AMP connector that mates with industry standard magnetic pickup distributors and crank triggers. To complete the installation, you may require additional wire and crimp terminals. The Appendix includes a list of recommended parts and suppliers.

Figure 1 – TCS-1 System



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## **WIRING OVERVIEW**

<b>Signal Connections (in order from left to right on terminal blocks)</b>	
+12V POWER	Connects to ignition switch. The TCS-1 is compatible with nominal 12-16 volt electrical systems.
MAG+ IN	Connects to magnetic pickup distributor or crank trigger. If the magnetic trigger inputs are used, the module trigger input (MOD TRIG IN) must be left open.
MAG- IN	Connects to magnetic pickup distributor or crank trigger. If the magnetic trigger inputs are used, the module trigger input (MOD TRIG IN) must be left open.
MOD TRIG IN	Connects to trigger output from a distributor with internal amplifier or engine control module. If the module trigger input is used, the magnetic trigger inputs (MAG+ IN and MAG- IN) must be left open.
MOD TRIG OUT	Connects to module/points trigger type input on a capacitive discharge ignition (MSD white wire or PTS terminal).
GPI1	General purpose input 1. Preprogrammed as a 2° retard input. Also used as input for RTD-1 retard command signal.
GPI2	General purpose input 2. Preprogrammed as a 3° retard input.
GPI03	General purpose input/output 3. Preprogrammed as a 3° retard input.
MAP POWER	5V power. Connects to MAP sensor and/or RTD-1 power.
MAP SIGNAL	Connects to 0-5V MAP sensor signal
MAP GROUND	Connects to MAP sensor and/or RTD-1 ground
NOT USED	
NOT USED	
GROUND	Connects to chassis ground.

Figure 2 – Basic Magnetic Trigger Hookup

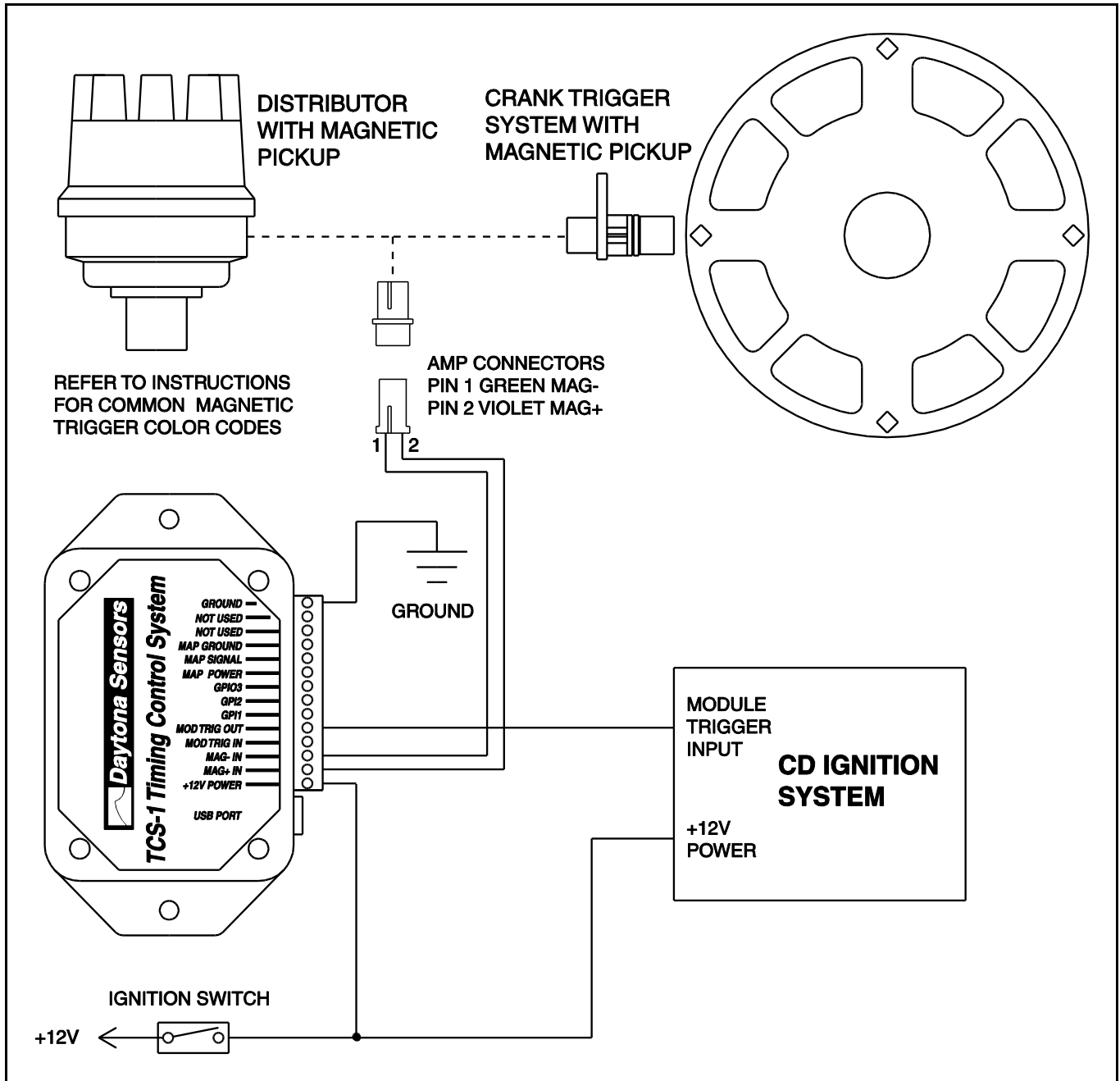
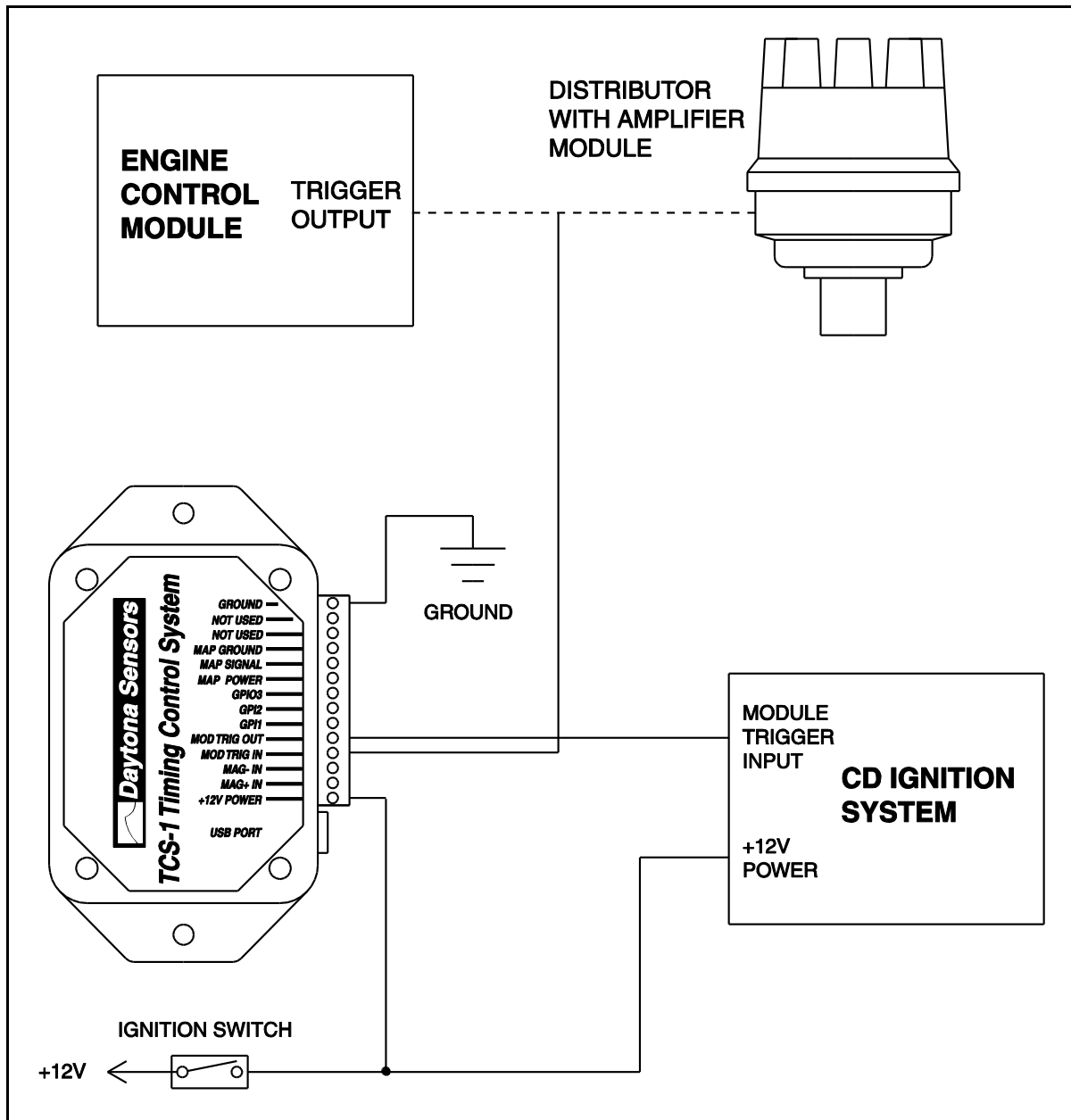


Figure 3 – Basic Module Trigger Hookup



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## INSTALLATION

1. Turn off the ignition switch and disconnect the battery ground cable before proceeding.
2. Select a convenient mounting location for the TCS-1. The unit is not sealed and must be mounted in a dry location away from sources of heat. We recommend under dash mounting. The unit is not intended for under hood mounting. You can secure the TCS-1 with two sheet metal screws or Velcro tape strips. Orient the unit so that you will have easy access to the terminal blocks and USB port.
3. Refer to Figures 2 or 3 for basic hookup. All signal connections can be made with 18-20 AWG wire.
4. **Working with clamping terminal blocks.** All connections to the TCS-1 terminal blocks must be clearly identified either by means of distinct wire colors or the use of wire labels. If you use distinct wire colors, mark up the appropriate figures on this instruction sheet for future reference. Refer to the Appendix for recommended wire labels. Wire should be stripped back 3/16-1/4 inch. No bare wire should be visible outside the terminal block. Use a miniature Phillips or flat screwdriver to tighten the screws.
5. **Ground connection.** Keep the ground connection as short as possible. The ground connection must go to a chassis ground stud (you can usually find one under the dash).
6. **+12V Power.** Connect to the ignition switch (or red wire on MSD units). Note that the TCS-1 is compatible with nominal 12-16 volt electrical systems.
7. **Trigger input signal connections.** The violet/green magnetic pickup cable is supplied with an AMP connector that will mate with common MSD magnetic pickup distributors and crank trigger systems. For other magnetic pickups, cut off the

connector and refer to the color code table below. For module triggered applications from distributors with internal amplifiers or engine control modules, the TCS-1 requires a 0-12V square wave signal and fires on the rising edge. The module trigger input is tolerant of high voltage pulses and has an internal 150 ohm pull-up resistor to +12V.

Magnetic Trigger Color Codes		
System	Mag-	Mag+
Accel/Chrysler Distributor	Black	Orange/White
Accel Crank Trigger	Black	White
Moroso Crank Trigger	White	Black
MSD Crank Trigger	Green/Black	Violet/Orange
MSD/Ford Distributor	Violet	Orange
GM Distributor	Green	White

8. **Module trigger output.** Connect to the white wire or terminal labeled PTS on MSD and other capacitive discharge ignition systems. The module trigger output is a 0-12V square wave signal and fires on the rising edge. It does not include an internal pull-up resistor as this is normally part of the input circuitry of capacitive discharge ignitions.
9. **Application specific signal connections.** Refer to the following sections and Figures 4-7.
10. **Completing the installation.** Reconnect the battery. Start engine and check timing. If timing above 3,000 RPM has changed significantly, MAG+ and MAG- may be reversed.

Figure 4 – Retard Switch Hookup

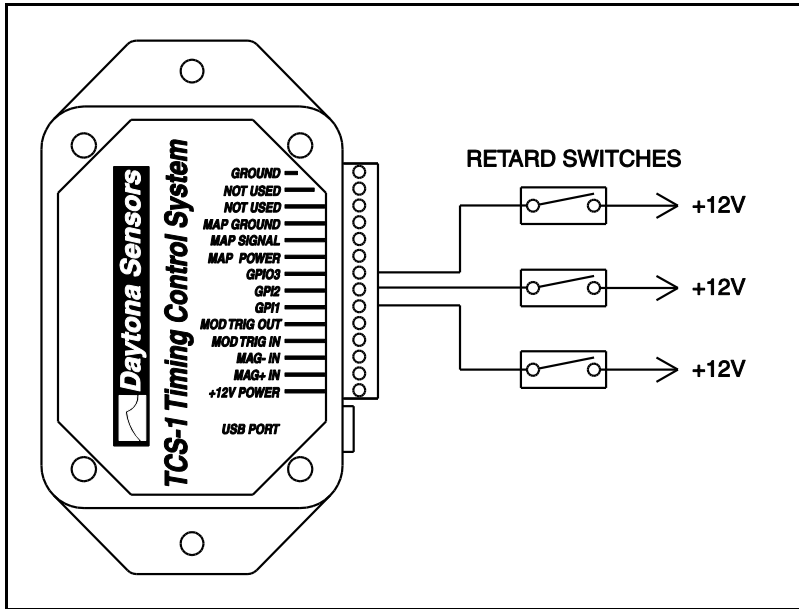


Figure 5 – MAP Sensor Hookup

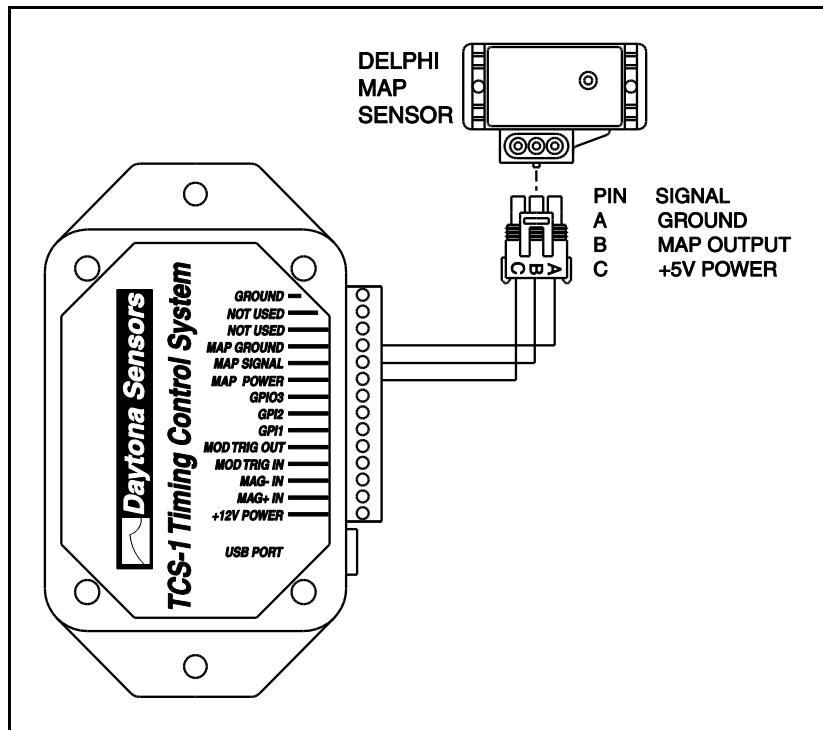


Figure 6 – RTD-1 Retard Control Hookup

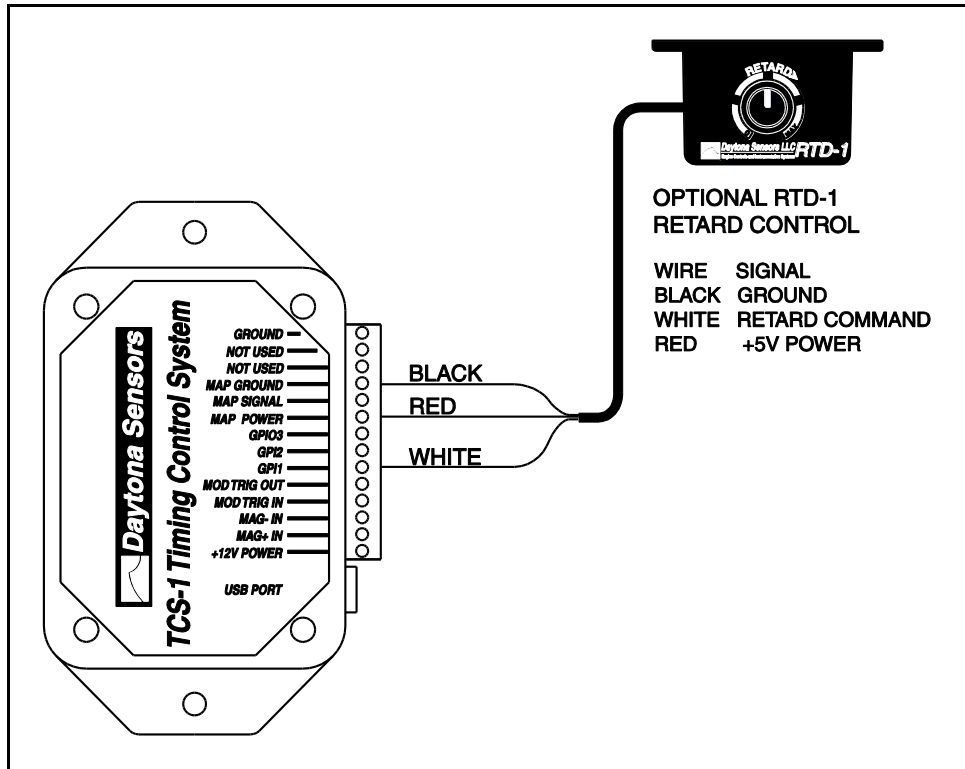
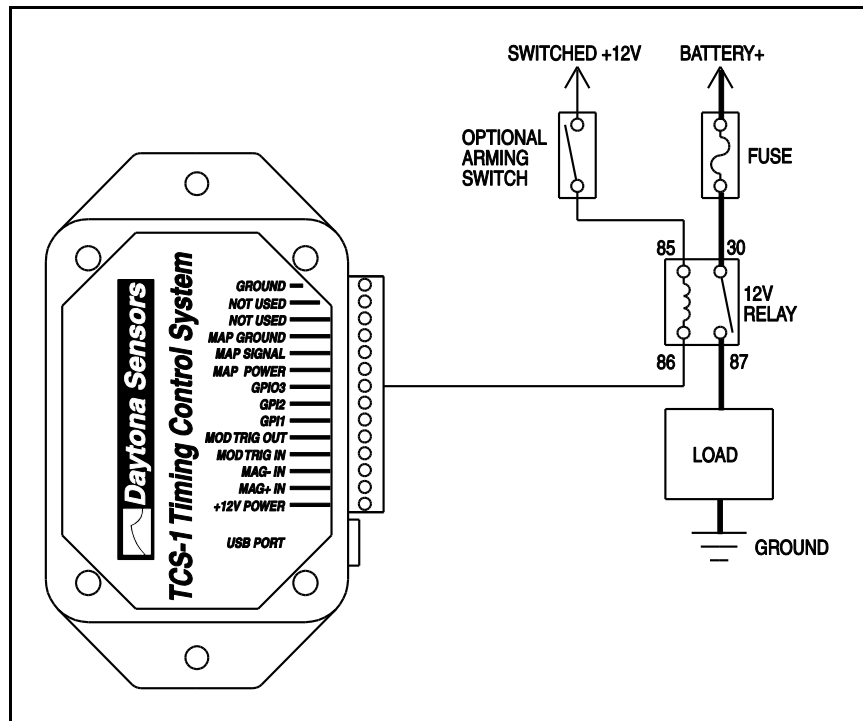


Figure 7 – RPM Window Switch Hookup



## Retard Switch Hookup

Refer to Figure 4. The general purpose input/output terminals are preprogrammed for 2°, 3°, and 4° retard functions. Retard is active when +12V is applied, either by means of a switch or some other external circuit. Individual switches can be connected to each terminal or several terminals can be connected together. For example, the TCS-1 will retard timing 9° if all three terminals are connected to a single switch. The PC Link TCS software can be used to independently program each terminal for 0-10° retard.

## MAP Sensor Hookup

A manifold absolute pressure (MAP) sensor is required for all applications that use a 3D timing table uploaded with the PC Link TCS software.

The optional MAP sensor harness includes mating connector shells for Delphi 1 bar, 2 bar, and 3 bar MAP sensors (refer to the Appendix for recommended MAP sensor part numbers). Select the connector shell with the appropriate indexing features for your MAP sensor. Connect the ground, MAP signal, and +5V power wires as shown in Figure 5.

## RTD-1 Retard Control Hookup

The RTD-1 retard control is required for 0-10° driver adjustable retard (GPI1 analog retard mode - refer to page 13 for details).

The RTD-1 unit is not waterproof and is intended for under dash mounting only. Connect the ground, retard command, and +5V power wires as shown in Figure 6.

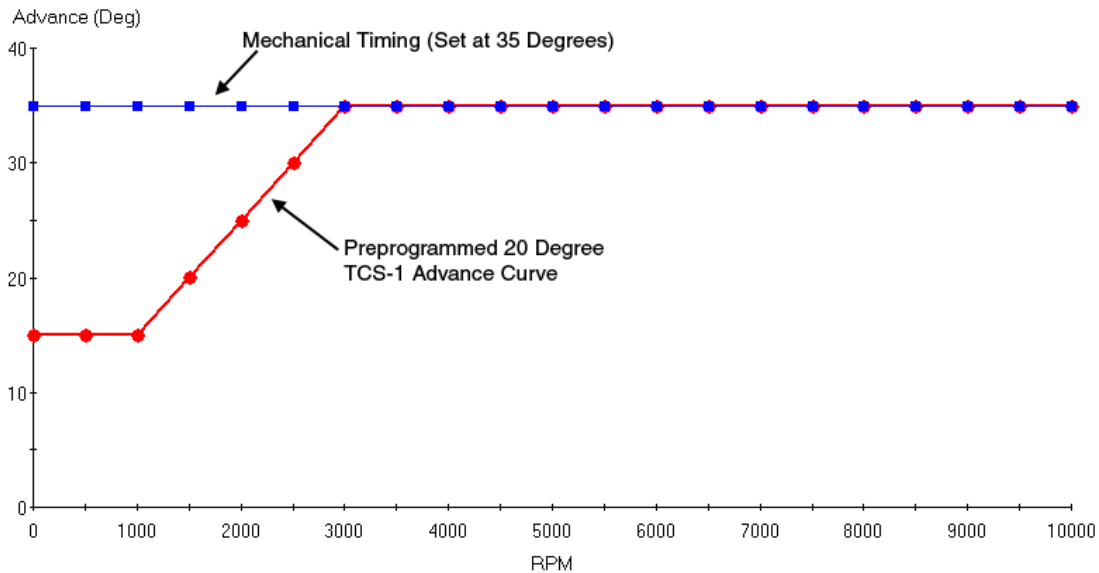
## RPM Window Switch Hookup

The PC Link TCS software can be used to program the GPIO3 terminal as an RPM window switch output. When active, the output can sink 1 amp current from a load returned to +12V (the output looks like a switch connected to ground). Figure 7 shows typical hookup using a relay to drive a higher current load. You can connect an optional arming switch as shown. For direct battery power connections, you should also install a fuse. Refer to the Appendix for recommended relays and fuses.

## BASIC OPERATION

The TCS-1 unit is factory preprogrammed with the timing curve shown in Figure 8. The general purpose input/output terminals are preprogrammed for 2°, 3°, and 4° retard functions.

Figure 8 – TCS-1 Preprogrammed Timing Curve



RPM	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500
ADV	15.0	15.0	15.0	20.0	25.0	30.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0



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## **PC LINK TCS SOFTWARE OVERVIEW**

Use of the software is optional and not required for basic operation of the TCS-1 system. If you are not planning on using the software, you can skip the rest of the material in this instruction manual.

PC Link TCS software runs under Microsoft Windows XP/Vista/7/8. This software allows the user to program TCS-1 units with custom timing advance tables and to configure the function of the general purpose input/output (GPIO) terminals and other engine parameters. The TCS-1 connects to your PC by means of a USB interface. A USB cable is supplied with the unit. The PC must have a free USB port. If you have an older PC without USB capability, you cannot use the unit.

When launched for the first time, the program uses COM1 as the default port. In most cases, you will have configured the unit's USB interface to use a different COM port, such as COM5. Use the Port Setup command on the Communications menu to select the correct COM port. The program will remember the new port setup.

PC communications is possible when power is turned on and the engine has not yet been started. Note that no damage or data corruption occurs if the engine is inadvertently started while the USB interface is connected.

After PC Link TCS is launched, the main screen appears blank. You have three options for obtaining setup data for editing. You can open a previously saved setup file by using the Open Table command on the File menu. You can create a new setup file by using (as applicable) the Edit Module Parameters and Edit GPIO Parameters commands from the Edit menu and the New Timing Table command on the File menu. You can also download data from an attached TCS-1 unit by using the Download From EEPROM command on the Communications menu.

Note that setup files use a .dat extension. You should create a separate folder to store these files.

If you have enabled a 2D or 3D timing table under module parameters, you can use the Edit Timing Table command from the Edit menu. You can edit the timing table data by clicking on and dragging individual points on the chart display or you can directly edit numeric data on the spreadsheet grid.

Once the appropriate parameters and timing table data have been entered, you can print the data using the Print Parameters and Timing Table

command on the Print Menu. You can save the edited setup file by using the Save Table command on the File menu.

You can upload the setup data to an attached TCS-1 unit by using the Upload to EEPROM command on the Communications menu.

A setup file (TCS1\_Sample.dat) is included in the program folder.

## **PC REQUIREMENTS**

The TCS-1 connects to your PC by means of a USB interface. The PC must have a free USB port. If you have an older PC without USB capability, you cannot use the software.

We recommend a laptop PC with Pentium processor and super VGA display (SVGA with 1024 x 768 pixel resolution) running Windows XP/Vista/7/8. Data chart display is graphics intensive and a high speed Pentium processor is recommended. Processors slower than 300 MHz will exhibit sluggish program loading and response.

PC Link TCS software includes print commands to print parameters and timing tables. The program has been tested with Hewlett-Packard laser and inkjet printers and Epson inkjet printers. We recommend using a color inkjet printer.

## **USB INSTALLATION**

If you have already installed the USB interface driver for the TCS-1, you can skip this step.

The USB interface for the TCS-1 is based on the FTDI FT232R chip and drivers that allow the unit to emulate a standard Windows RS-232 COM port. Updated Windows drivers, installation instructions and troubleshooting tips are available on the FTDI website at [www.ftdichip.com](http://www.ftdichip.com). Additional information and troubleshooting tips can be found on the PC Link Tech FAQ on our website.

A new USB driver that simplifies the installation process is available. This installs as an executable file, similar to other Windows programs. The Windows Found New Hardware Wizard will then detect the USB device when it is first connected and automatically install the correct driver without the user having to browse out.

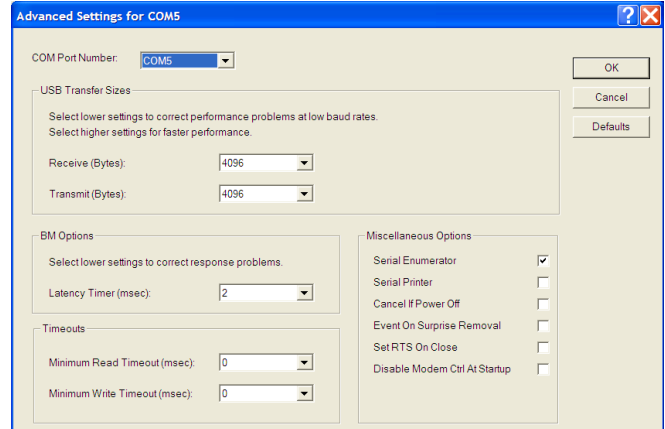
Before proceeding with installation, shutdown any other applications that may be running. For Windows Vista, you must disable the User Account Control (UAC) during installation. If you are not familiar with the UAC, please refer to the Vista UAC Tech Note on our website's PC Link Tech FAQ for details.

1. Make sure the unit is not connected to your PC.
2. From the Website download the Software under the Tech Center tab in the software library folder. Scroll down and click on the USB Driver link. When the File Download dialog box appears, click on "Run this program from its current location." Ignore any security warnings and click on Yes to continue.
3. After installation of the driver is complete, connect the unit to the PC with the supplied USB cable. The Windows Found New Hardware Wizard will appear and complete installation of the USB driver.

## COM Port Configuration

After completing the installation steps outlined above, you must configure the new COM port using Device Manager.

1. **Windows XP:** click Start, Settings, Control Panel, System, Hardware, and then Device Manager.  
**Windows Vista:** click Start, Control Panel, System and Maintenance, and then Device Manager.  
**Windows 7:** Click Start, Control Panel, System and Security, and then Device Manager. For more information, visit [www.pcsupport.about.com](http://www.pcsupport.about.com).
2. Scroll down to Ports (COM and LPT). The new unit will appear as USB Serial Port. Click on this new port. Click on the Port Settings tab.
3. Click on Advanced. In most cases the wizard will have installed your new unit as COM5. Note the COM port number assigned for your system. For optimum performance, you should also change the BM Options Latency Timer to 2 msec as shown in the Figure.
4. Once you have configured a COM port number for your new unit, make sure that you use this same COM port selection in the software by using the Port Setup command from the Communications menu.



## SOFTWARE INSTALLATION

The software is supplied in the form of a compressed file downloaded from our website. The installation process uses InstallShield. This industry standard installer is based the new Microsoft Windows Installer service that greatly reduces potential problems such as version conflicts and allows for application self-repair.

Before proceeding with installation, shutdown any other applications that may be running. For Windows Vista, you must disable the User Account Control (UAC) during installation. If you are not familiar with the UAC, please refer to the Vista UAC Tech Note on our website's Tech FAQ for details.

Use the Windows Explorer to launch the PC\_Link\_TCS setup.exe file downloaded from our website. InstallShield will install the software in an appropriate folder under Program Files.

Once InstallShield has completed the installation, PC Link TCS will appear on the Windows Start Menu. You can then launch it just as you would any other Windows program.

PC Link TCS software requires the Monospace 821 BT fixed pitch printer font in order to properly align columns when printing. The Monospace 821 BT font is included in the distribution media and automatically copied to your Windows Fonts folder during installation. A backup copy is also placed in the program folder. If you accidentally delete this font, use the Install New Font command from the Fonts folder File menu. The filename associated with Monospace 821 BT is monos.ttf.

Figure 9 – COM Port Configuration

## DOWNLOADING DATA FROM EEPROM

Connect the USB cable and turn on power to the TCS-1. Do not start the engine.

When launched for the first time, the program uses COM1 as the default port. In most cases, you will have configured the USB interface to use a different COM port, such as COM5. Use the Port Setup command on the Communications menu to select the correct COM port. The program will remember the new port setup.

Download data by using the Download From EEPROM command on the Communications menu.

If the download process is successful, the module parameters are displayed. You can then edit setup data as explained in subsequent sections.

TCS-1 units are shipped from the factory with default parameters and timing tables loaded into

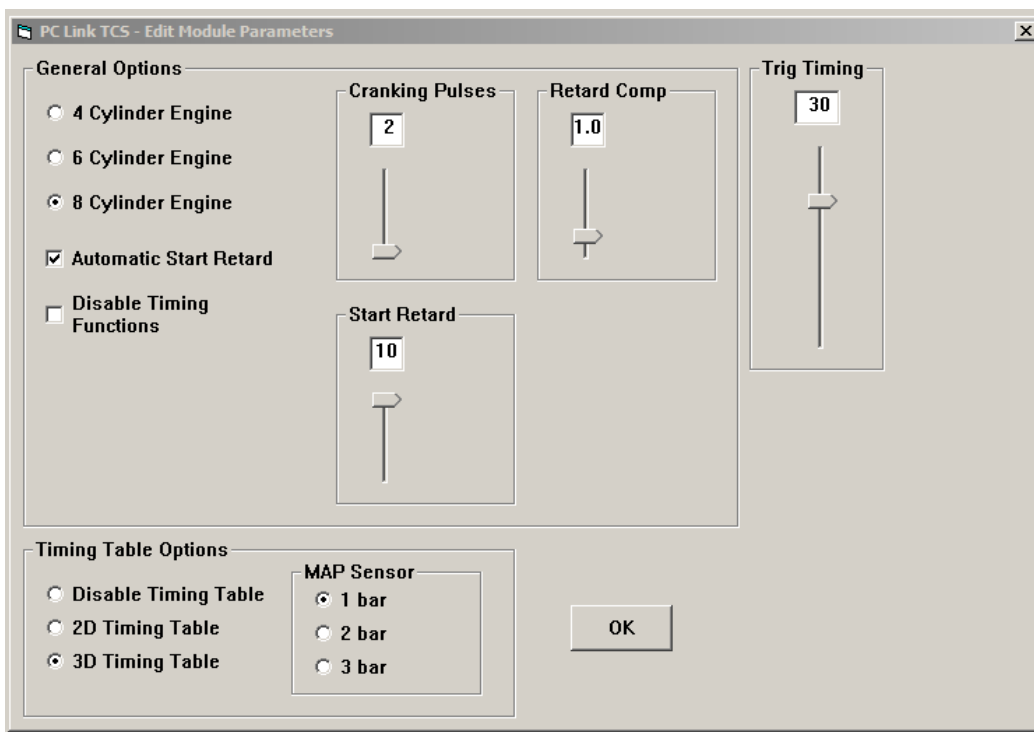
EEPROM memory. If you have never uploaded any custom setup file to EEPROM memory, these defaults are what you will see.

## MODULE PARAMETERS

Module parameters are displayed in a dialog box by using the Edit Module Parameters command on the Edit menu. Module parameters control the overall operation of the TCS-1 unit.

When PC Link TCS is first started, default module parameters are loaded. Module parameters are updated whenever you download data from a TCS-1 unit or open a setup file. Module parameters are saved along with the GPIO parameters and timing table data when you save a setup file. **Always check the module parameters before uploading data to the TCS-1.**

Figure 10 – Module Parameters



### General Options

**4, 6, or 8 Cylinder Engine** - sets the engine type. 8 cylinder engine is the default. You must select the correct engine type for proper scaling of RPM limit and timing control functions.

**Automatic Start Retard** - selecting this option enables the automatic start retard and the start retard slider is displayed. You can set a start retard value from zero to 10 degrees. The automatic start retard is active for 10 engine revolutions after engine start while the engine is running below 450 RPM.

**Disable Timing Functions** - all timing functions including the automatic start retard and any timing table are disabled.

**Cranking Pulses** - the slider sets the number of trigger pulses (events) before the TCS-1 fires the first spark. For a V8 engine, there are 4 trigger pulses per revolution. To prevent spurious firing when the ignition key is turned on, you should always use a value of 2 or higher.

**Retard Comp** - the slider allows fine tuning the timing to eliminate the effects of spark firing delay and the intrinsic delay of some magnetic pickup systems. A typical value is 1.5 degrees. Check the timing with a timing light. If a noticeable retard is observed between 2,000 RPM and the upper RPM range of the engine, use a higher value for retard compensation.

### Timing Table Options

**Disable Timing Table** - no timing table is active.

**2D Timing Table** - enables a 2D timing table with timing based on engine RPM.

**3D Timing Table** - enables a 3D timing table with timing based on engine RPM and manifold absolute pressure (MAP). The MAP sensor option box appears. You can select a 1 bar, 2 bar, or 3 bar MAP sensor. To use the 3D timing table, a MAP sensor must be connected. Refer to Figure 5 and page 8 for details.

### Trigger Timing

The TCS-1 and similar competitive products require a trigger signal (magnetic pickup or 12V module output) with a single pulse per firing event. The rising edge of the trigger pulse is the most advanced

timing (earliest spark firing) that the unit can generate. All timing curves and other timing functions are based on delaying the spark firing referenced to the trigger pulse. Refer to page 17 for additional information on trigger timing.

Set the Trig (Trigger) Timing slider value to correspond to the actual advanced timing point (degrees BTDC) of your trigger signal. The trigger timing value represents the most advanced timing that the TCS-1 can generate. The default value is 30 degrees BTDC, but you must enter the actual value for your engine (or adjust your trigger system so that it generates a trigger signal at 30 degrees BTDC).

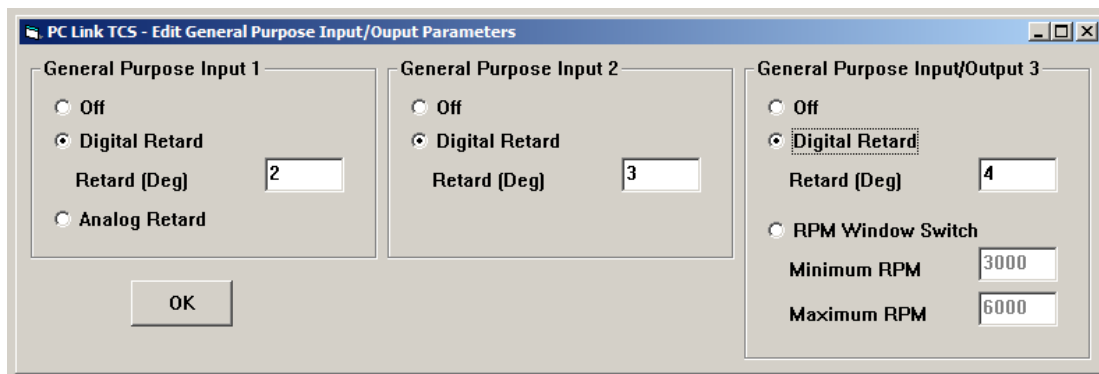
Timing table data “tracks” the trigger timing value. The table values always represent the actual engine timing that will result if the trigger system generates a pulse corresponding to the trigger timing value.

## General Purpose Input/Output Parameters

General purpose input/output (GPIO) parameters are displayed in a dialog box by using the Edit GPIO Parameters command on the Edit menu. GPIO parameters control the function of the GPI1, GPI2, and GPIO3 terminals on the TCS-1 unit.

When PC Link TCS is first started, default GPIO parameters are loaded. GPIO parameters are updated whenever you download data from a TCS-1 unit or open a setup file. GPIO parameters are saved along with the module parameters and timing table data when you save a setup file. **Always check the GPIO parameters before uploading data to the TCS-1.**

Figure 11 – GPIO Parameters



## General Purpose Input 1 (GPI1)

GPI1 has three modes:

**Off** - the GPI1 input is disabled.

**Analog Retard** - refer to the TCS-1 instructions for details. The optional RTD-1 retard control is connected to GPI1, the +5V reference supply, and signal ground on the TCS-1. The RTD-1 can be used to dial in a zero to 10 degree retard. Zero volts on GPI1 corresponds to zero retard and +5V corresponds to 10 degrees retard. This mode can be used as a driver adjustable timing function.

**Digital Retard** - you can enter a retard value from zero to 10 degrees. The retard will be active whenever a +12V signal level is detected on GPI1.

## General Purpose Input 2 (GPI2)

GPI2 has two modes:

**Off** - the GPI2 input is disabled.

**Digital Retard** - you can enter a retard value from zero to 10 degrees. The retard will be active whenever a +12V signal level is detected on GPI2.

## General Purpose Input/Output 3 (GPIO3)

When configured as an output, GPIO3 can switch a 1 amp load to ground. A relay must be used to control larger loads, such as solenoid valves. GPIO3 has three modes:

**Off** - the GPIO3 function is disabled.

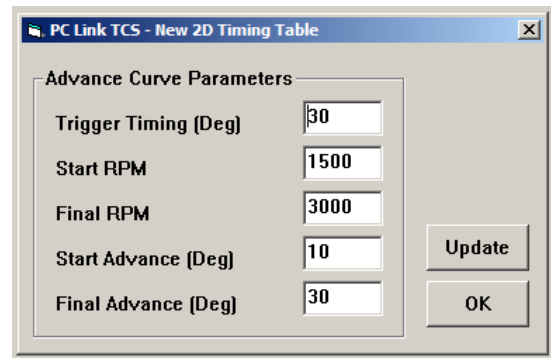
**Digital Retard** - you can enter a retard value from zero to 10 degrees. The retard will be active whenever a +12V signal level is detected on GPIO3.

**RPM Window Switch** - the GPIO3 output will be active (switched to ground) whenever engine RPM is within the minimum and maximum values.

## CREATING A NEW TIMING TABLE

If you are creating a new setup file, you must first select the 2D or 3D timing table option under module parameters as explained in the Module Parameters section. You can then use the New Timing Table command on the File menu. A dialog box appears as shown in Figure 12 or 13 depending on the type of timing table you selected.

Figure 12 – New 2D Timing Table Dialog

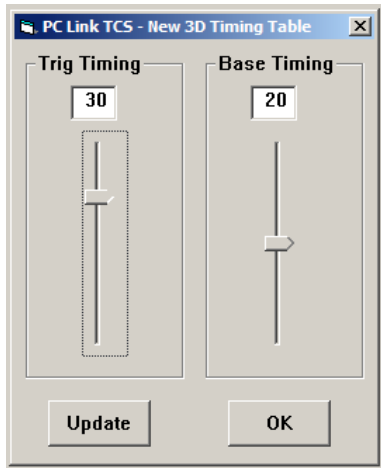


## New 2D Timing Table

For a new 2D timing table, you can enter the trigger timing, start and final RPM, and start and final advance. A new value of trigger timing overrides and updates whatever value you may have previously entered under module parameters. Set the trigger timing value to correspond to the actual advanced timing point (degrees BTDC) of your trigger signal. The trigger timing value represents the most advanced timing that the TCS-1 can generate. The default value is 30 degrees BTDC, but you must enter the actual value for your engine (or adjust your trigger system so that it generates a trigger signal at 30 degrees BTDC). Trigger timing is shown on the graph as a straight blue line. The actual timing advance curve is shown in red. Since trigger timing represents the most advanced timing, the red timing curve can never go above the blue trigger timing line. The total timing range of the TCS-1 is limited to 22 degrees to prevent possible crossfiring into the next cylinder. For example, if you set trigger timing to 30 degrees, the actual advance range is 8.0 to 30 degrees. The program will not allow you to enter values outside this range.

Each time you click on Update, the corresponding timing advance table is displayed. You will find the New Timing Table command useful for generating a timing advance table that will serve as a starting point for further edits. When you are ready to proceed with editing, click on OK.

Figure 13 – New 3D Timing Table Dialog



### New 3D Timing Table

For a new 3D timing table, you can enter the trigger timing and a base timing value. The base timing value is used to generate a flat timing table. A new value of trigger timing overrides and updates whatever value you may have previously entered under module parameters. Set the trigger timing slider to correspond to the actual advanced timing point (degrees BTDC) of your trigger signal. The trigger timing value represents the most advanced timing that the TCS-1 can generate. The default value is 30 degrees BTDC, but you must enter the actual value for your engine (or adjust your trigger system so that it generates a trigger signal at 30 degrees BTDC). Since trigger timing represents the most advanced timing, the 3D timing table values can never exceed the trigger timing. The total timing range of the TCS-1 is limited to 22 degrees to prevent possible crossfiring into the next cylinder. For example, if you set trigger timing to 30 degrees, the actual advance range is 8.0 to 30 degrees. The program will not allow you to enter values outside this range.

Each time you click on Update, the corresponding timing advance table is displayed. You will find the New Timing Table command useful for generating a timing advance table that will serve as a starting point for further edits. When you are ready to proceed with editing, click on OK.

## EDITING TIMING TABLE DATA

Once you have timing advance table data, you can edit the data by clicking on and dragging individual points on the chart display or you can directly edit numeric data on the spreadsheet grid.

### 2D Timing Table

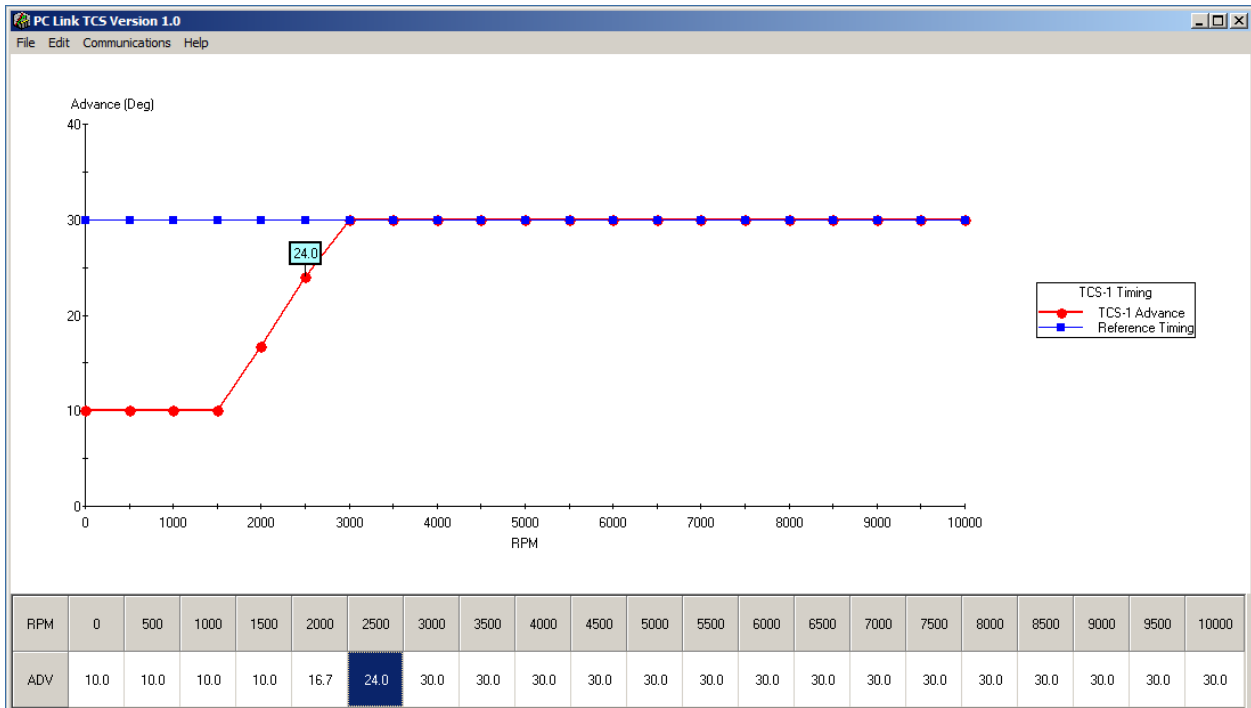
The table consists of 21 columns corresponding to 500 RPM increments from zero to 10,000 RPM. The 10,000 RPM timing value is used at all higher RPM levels.

The trigger timing value represents the most advanced timing that the TCS-1 can generate. The default value is 30 degrees BTDC, but you must use the actual value for your engine (or adjust your trigger system so that it generates a trigger signal at 30 degrees BTDC). If you need to change the trigger timing value, go back to module parameters. Trigger timing is shown on the graph as a straight blue line. The actual timing advance curve is shown in red. Since trigger timing represents the most advanced timing, the red timing curve can never go above the blue trigger timing line. The total timing range of the TCS-1 is limited to 22 degrees to prevent possible crossfiring into the next cylinder. For example, if you set trigger timing to 30 degrees, the actual advance range is 8.0 to 30 degrees. The program will not allow you to enter values outside this range.

There is a slight signal delay within the TCS-1 and associated capacitive discharge ignition system. This affects the maximum advance that can be generated at high RPM. You should leave about 1 degree headroom between the maximum advance value on your table and the reference (trigger) timing value. For example, if your reference timing is 30 degrees, you should not use timing table values exceeding 29 degrees above 3,000 RPM.

PC Link TCS is intended to be an open system and uses the Component One Chart 7.0 2D charting control. The adventurous user can experiment with the chart property pages by right clicking on the chart. Almost any chart property can be changed. Click on the Help button for more information. If you corrupt the chart, exit and restart PC Link TCS.

Figure 14 – 2D Timing Table



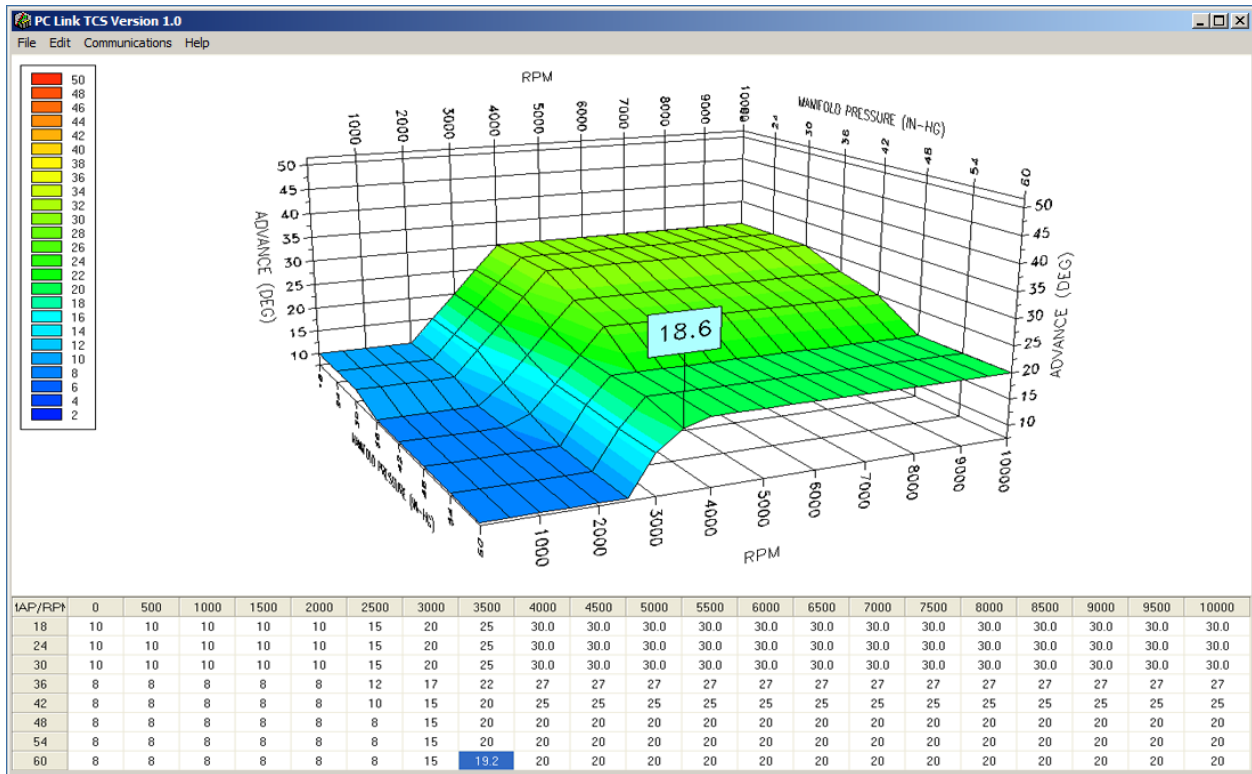
### 3D Timing Table

The 3D timing advance table consists of 21 columns corresponding to 500 RPM increments from zero to 10,000 RPM and 8 manifold pressure (MAP) rows. The MAP range depends on the type of MAP sensor selected under module parameters. The timing value at 10,000 RPM is used at all higher RPM levels and the timing value in the lowest MAP row is used at all lower MAP levels. Note that 30 In-Hg corresponds to atmospheric pressure (zero boost). Normally aspirated engines will not exceed 30 In-Hg and not all supercharged engines will reach the maximum MAP level for 2 bar or 3 bar MAP sensors. The trigger timing value represents the most advanced timing that the TCS-1 can generate. The default value is 30 degrees BTDC, but you must use the actual value for your engine (or adjust your trigger system so that it generates a trigger signal at 30 degrees BTDC). If you

need to change the trigger timing value, go back to module parameters. Since trigger timing represents the most advanced timing, the 3D timing table values can never go exceed the trigger timing. The total timing range of the TCS-1 is limited to 22 degrees to prevent possible crossfiring into the next cylinder. For example, if you set trigger timing to 30 degrees, the actual advance range is 8.0 to 30 degrees. The program will not allow you to enter values outside this range.

There is a slight signal delay within the TCS-1 unit. This affects the maximum advance that can be generated at high RPM. You should leave about 1 degree headroom between the maximum advance value on your table and the reference (trigger) timing value. For example, if your reference timing is 30 degrees, you should not use timing table values exceeding 29 degrees above 3,000 RPM.

Figure 15 – 3D Timing Table

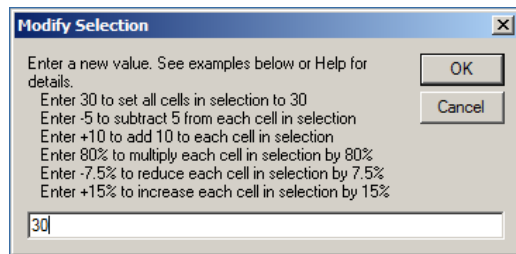


You can rotate the 3D chart display for a better view of a particular region by dragging the mouse while holding both mouse buttons down. PC Link TCS is intended to be an open system and uses the Component One Chart 7.0 3D charting control. The adventurous user can experiment with the chart property pages by right clicking on the chart. Almost any chart property can be changed. Click on the Help button for more information. If you corrupt the chart, exit and restart PC Link TCS.

### Editing Spreadsheet Table Data

You can edit table data using standard Windows copy and paste operations by selecting cells and then clicking the right mouse button to pop-up the edit menu. You can select cells by dragging the mouse with the left button down. You can also use the Modify command on the pop-up menu. When you enter a value, the presence of optional sign (+ or -) or percent (%) characters affects the outcome of the Modify command.

Figure 16 – Modify Command



### Data Export and Import by Means of Copy and Paste

You might want to export or import table data to or from another application such as Microsoft Excel and other programs with tables that support copy and paste operations. You can directly copy and paste data to and from the PC Link TCS program. In the PC Link TCS program, you can select a range of cells with the mouse and right click to bring up a copy and paste menu. When you paste data into the PC Link TCS program, the data is automatically checked and any out-of-range data corrected.



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## UPLOADING DATA TO EEPROM

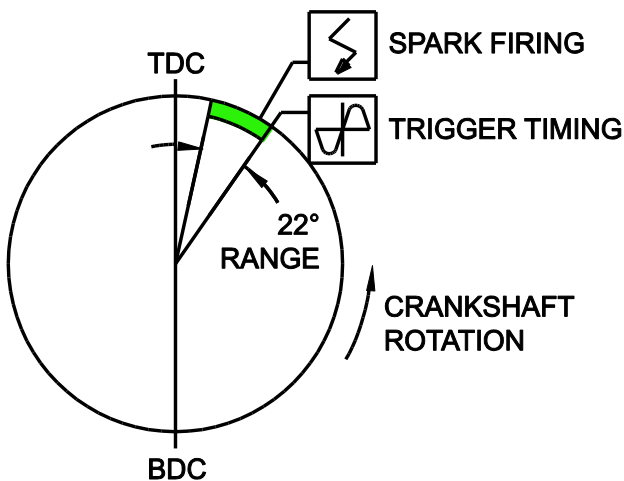
Refer to the Downloading Data from EEPROM section on page 11 for details about USB cable hookup and COM port setup. Before uploading, make sure the parameters and timing tables are correct.

Upload data by using the Upload To EEPROM command on the Communications menu. A status message is displayed when the upload process has been successfully completed.

## TRIGGER TIMING CONSIDERATIONS

Refer to Figure 20. The trigger timing value set under module parameters must correspond to the actual timing point (degrees BTDC) of your trigger signal. The trigger signal can come from a magnetic pickup crankshaft position sensor, magnetic distributor pickup, or 12V module trigger signal from another system such as an electronic engine control module (ECM). The trigger timing value represents the most advanced timing that the TCS-1 can generate. The default value is 30 degrees BTDC, but you must enter the actual value for your engine (or adjust your trigger system so that it generates a trigger signal at 30 degrees BTDC). Since trigger timing represents the most advanced timing, the timing table values can never exceed the trigger timing. The total timing range of the TCS-1 is limited to 22 degrees to prevent possible cross firing into the next cylinder. For example, if you set trigger timing to 30 degrees, the actual advance range is 8.0 to 30 degrees (shaded area in Figure 20).

Figure 17 – Trigger Timing



## Magnetic Pickup Crankshaft Position (CKP) Sensor

You can accurately establish the position of the CKP sensor by temporarily disabling multi-spark and any timing table in module parameters (remember to upload to TCS-1). Use a timing light to check the timing and adjust the position of the CKP sensor as required so that your observed engine timing is the same as the trigger timing value. For best accuracy, we suggest that you set the timing at 1,500-2,000 RPM. While you are conducting this test, you should also check the distributor phasing. Use a spare distributor cap and drill or mill a large hole on the top or side so that you can observe the rotor tip position at cylinder 1 with the timing light. If you are using a dial-back timing light, set the dial-back to zero while observing rotor tip position. The leading edge of the rotor should just touch the cap terminal.

## Magnetic Pickup Distributor without Advance Mechanism

You can accurately establish the position of the distributor by temporarily disabling multi-spark and any timing table in module parameters (remember to upload to TCS-1). Use a timing light to check the timing and adjust the position of the distributor as required so that your observed engine timing is the same as the trigger timing value. For best accuracy, we suggest that you set the timing at 1,500-2,000 RPM.

## Magnetic Pickup Distributor with Advance Mechanism

In this case, you will not be using a timing table, but you might still want to use the retard features and data logging. Set the trigger timing value to correspond to the maximum distributor advance at high RPM.

## Module Trigger from an ECM

In this case, you will not be using a timing table, but you might still want to use the retard features and data logging. Set the trigger timing value to correspond to the maximum advance generated by the ECM at high RPM.

## APPENDIX – RECOMMENDED PARTS AND SUPPLIERS

Note: replace X with color code B=Black, W=White, R=Red, G=Green, A=Orange, Y=Yellow, L=Blue, N=Brown, S=Gray, V=Violet

### MAP SENSORS

To connect a Delphi MAP sensor for boost timing retard mode or for implementing a 3D timing table, you will have to fabricate a wiring harness with the appropriate mating connector or use our MAP sensor harness kit P/N 102006. Recommended Delphi MAP sensors, and equivalent aftermarket parts are listed in the table below. Note that Wells is stocked by Autozone ([www.autozone.com](http://www.autozone.com)) and SMP (Standard Motor Products) is stocked by RockAuto ([www.rockauto.com](http://www.rockauto.com)).

Range	Delphi P/N	Aftermarket P/Ns
1 bar (normally aspirated engines)	12219927, 16254719, 16175339, 12247561	Wells SU105 SMP AS165
2 bar (0-15 psi boost)	16009886	Wells SU129 SMP AS4
3 bar (0-30 psi boost)	12223861	Wells SU504 SMP AS210

### WIRE

Wire supplied with most automotive accessories is usually un-tinned copper with a low number of strands. The unprotected copper in this inexpensive wire quickly oxidizes, especially when in contact with dissimilar metals on terminals. The low number of strands limits life in applications where flexing occurs. We recommend the use of high quality industrial grade wire with tinned copper strands and a high strand count.

18-20 AWG sizes can be used for all signal and low current applications. 16-18 AWG is adequate for line lock and trans brake solenoid wiring. 14 AWG should be used for high current fuel and nitrous solenoid wiring. Carol UL grade 1007/1015 wire is available from Digi-Key.

P/N	Description
C2040X-100	20 AWG wire (100 foot spool)
C2064X-100	18 AWG wire (100 foot spool)
C2104X-100	16 AWG wire (100 foot spool)
C2105X-100	14 AWG wire (100 foot spool)

### CRIMP TERMINALS

High quality crimp terminals and a proper crimping tool are required to make reliable electrical connections. Crimp terminals commonly sold in automotive and hardware stores have brittle vinyl insulation that easily cracks. We recommend the use of high quality industrial grade nylon insulated crimp terminals. The following parts are available from Digi-Key.

P/N	Description
A27241	16-20 AWG #10 ring tongue terminal
A27246	16-20 AWG 1/4" ring tongue terminal
A27248	16-20 AWG 3/8" ring tongue terminal
A27262	14-16 AWG 1/4" ring tongue terminal
A27264	14-16 AWG 3/8" ring tongue terminal
A27288	10-12 AWG 1/4" ring tongue terminal
A27291	10-12 AWG 3/8" ring tongue terminal
A0911	18-22 AWG .110" female quick disconnect terminal
MNU18-187DFIK	18-22 AWG .187" female quick disconnect terminal
MNU18-250DFIK	18-22 AWG 1/4" female quick disconnect terminal
MNU14-250DFIK	14-16 AWG 1/4" female quick disconnect terminal
A1069	16-22 AWG butt splice
A1080	14-16 AWG butt splice
A1086	10-12 AWG butt splice

### RELAYS

The typical import brand 30-40 amp relays leave little safety margin. When used to switch heavy inductive solenoid loads, arcing can result in the contacts welding together – a potentially catastrophic failure mode. We recommend using Tyco/P&B automotive OE grade relays available from Newark Electronics and Digi-Key. Use the 40 amp version for most applications and the 70 amp version for fuel/nitrous solenoid activation. We recommend that you use the relay sockets and crimp terminals listed along with the relays.

P/N	Description
1432791-1	40 amp VF4 series relay
VCF4-1001	Socket for VF4 series relay

60249-1	12-16 AWG terminal for VF4
VF7-41F11	70 amp VF7 series relay
VCF7-1000	Socket for VF7 series relay
42281-1	14-18 AWG terminal for VF4 coil connections (2 required)
280756-4	10-14 AWG terminal for VF7 contact connections (2 required)

**FUSES AND FUSE TAPS**

ATC series fuses and fuse holders commonly used for automotive applications are only available in 40 amp and lower ratings. For high current applications, we recommend the heavy duty 50 amp Littlefuse Maxi Fuse series available from Digi-Key.

<b>P/N</b>	<b>Description</b>
F1085	Maxi fuse block
F1038	50 amp Maxi fuse

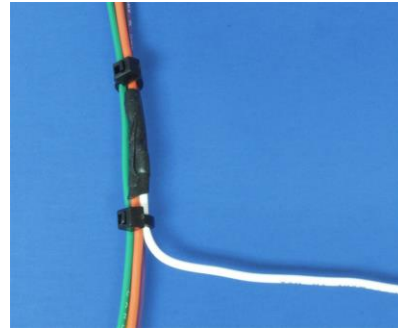
**SWITCHES**

All switches used in performance applications should be sealed. Representative sealed toggle and rocker style switches available from Digi-Key are listed below.

<b>P/N</b>	<b>Description</b>
480-2191	Honeywell SPDT toggle switch
360-2278	NKK SPDT rocker switch

**RELIABLE CONNECTIONS TO EXISTING SIGNALS**

For some applications, you may have to tap into existing signal wires on the vehicle. We caution against using any of the so called “vampire clips” that make an insulation displacement connection. These have proven very unreliable in racing applications. They may even cause the original wire to fray and break. We suggest soldering any connections to existing signals. Use a stripping tool to cut through and push back about 1/4” of insulation at the spot on the original wire where you plan to make the connection. Wrap several turns of the new wire around, solder, insulate with self vulcanizing electrical tape, and use two cable ties to secure the splice as shown. Regular electrical tape will tend to unravel. Self vulcanizing electrical tape is available from Digi-Key as their P/N W213.



**SUPPLIERS**

Suppliers referenced in the Appendix are listed in the table below. Additional suppliers for connectors, electronic tools, mechanical hardware, and test equipment are listed on our website at [www.daytona-sensors.com/tech\\_tools.htm](http://www.daytona-sensors.com/tech_tools.htm).

<b>Supplier</b>	<b>Phone</b>	<b>Website</b>
Digi-Key	1-800-344-4539	<a href="http://www.digi-key.com">www.digi-key.com</a>
Mouser	1-800-346-6873	<a href="http://www.mouser.com">www.mouser.com</a>
Newark	1-800-463-9275	<a href="http://www.newarkinone.com">www.newarkinone.com</a>
State Wire & Terminal	1-800-922-6527	<a href="http://www.statewire.com">www.statewire.com</a>