TECHNICAL MANUAL

Perfect Power

SMART TUNER

Product Marketing
by: Digital TECHNOLOGY (pty) ltd

SMART TUNER
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Index:

1. APPLICATIONS

The ***SMART TUNER*** comes in 6 versions, each for a specific application. This manual applies to all versions. Each function explanation in the manual is marked as to the applicable version.

The following versions are available:

PRO: One fuel input / output for analog tuning
One fuel input/output for frequency tuning
One ignition input/output for advance/retard
Road speed governor

ADV: One fuel input/output for analog tuning
One ignition input/output for advance/retard
Missing tooth method with special outputs
Road speed governor

SUPER: One fuel input/output for analog tuning
TWO ignition input/output for retard of random signals
Road speed governor

MEGA: One fuel input/output for analog tuning
TWO ignition input/output for advance/retard specific engines
Road speed governor

AONI: One fuel input / output for analog tuning.

2. FEATURES

Some of the following features are only available on some units. But it is safe to say that with the ever-advancing microelectronics, and with our firm commitment to product upgrades, our future units will have all features combined in to one.

Small size	:	Fits anywhere, can be hidden
Flyleads	:	No connection problem, colour coded
Low current Consumption	:	Does not generate heat
Plastic housing	:	No contact possible to other items
Protection	:	Against miss-connections up to 15 volts.
Encapsulated	:	Against moisture, vibrations, dust
Road speed governor	:	Can increase/decrease speed limit
128 fuel sites	:	For very smooth tuning
128 ignition sites	:	Very fine ignition tuning
2 Maps	:	Switcheable while you drive
Analog map deflection	:	Step and graduation selectable
RPM map deflection	:	Settable to desired tuning range
Software map Protection	:	Optional with password
DOS software version	:	Free from the Internet
WINDOWS software Version	:	For the most intricate tuning application More features than DOS version.

Engine profiles	:	Easy setup in WINDOWS
Signal conditioning	:	To prevent miss-trigger and spurious inputs
Very fast computing	:	To facilitate quick engine response
Low component count	:	High MTBF
Maximum rpm recording	:	Keeps the highest experienced RPM
Frequency fuel tuning	:	Makes tuning POSSIBLE!

3. SELECT THE RIGHT UNIT

In order to select the right unit for your engine, you should ask for the

ENGINE PROFILE (WINDOWS)

If this is not available, then you have no choice but measure some engine parameters with an oscilloscope and a voltmeter.

NOTE:

Most engines (ECU's) allow you to: decrease fuel slightly, (or increase) tune the ignition with two wires, but this is not guaranteed. If a certain ECU map does not allow more fuel, then you can't add any. If the ignition tuning is linked to 2 signals, then you can tune it, but if the ECU likes 3 signals, then you can't. There is no rule! You have to try it. Unless an engine profile exists, and someone has verified it.

Then there is the amount of tuning you desire: The bigger the changes are, the bigger the chances are that you don't succeeded.

So lets test you engine as to the suitability:

Analog map deflection:

You need a signal, which varies somewhere between 0 and 5 volts (e.g. from 2 to 3 volts) as you apply throttle. The signal could come from: Throttle sensor, AMP sensor, Airflow meter. If you haven't got one: make one! Fit external throttle potentiometer.

RPM deflection:

Never a problem! Find a signal, which repeats every firing. In some instances it can repeat every revolution (eg: missing tooth).

Fuel tuning:

It can be the same as the ANALOG_DEFL signal. It must be in the range from 0 to 5 volts. If you disconnect it from the ECU then the engine should run rich. Check with an oscilloscope if the signal is a frequency or a voltage. If a frequency, then check the frequency at idle and under full throttle. Frequency airflowmeters and frequency AMP sensors are available. Check each!

Ignition tuning:

You need to check each crank and cam sensor with an oscilloscope. If you have a wasted spark ignition, then the ECU needs two inputs or a missing tooth signal. Some engines have 3 pickups. Disconnect one and find out if the engine runs without it. Will it start without it? Engines with a distributor need one pickup signal.

Road speed governor tuning:

Find a signal, which originates on the gearbox or drive train. Automatic gearboxes with electronic shift use a lot of other signals. Find the one, which ONLY affects the road speed limit. For some engines the road speed governor is integral to the gear switching and can't be removed.

A later version of the SMART TUNER has a road speed LIMITER, which works with integrated pickup signals, because the signal is only tuned (affected, limited!) when the high speed is reached. Even then some ECU's link the roadspeed to the RPM in high gear, and any discrepancy results in some error codes, or service lights.

The above may have discouraged you from attempting to tune your engine. Granted, on some engines you can't tune everything, but on all engines you can tune something.

ONCE YOU HAVE ESTABLISHED THE AVAILABILTY OF SIGNALS, THEN SELECT THE UNIT:

Fuel tuning:

Frequency signal : PRO

Analog signal : PRO, ADVANCE, AONI

Ignition tuning:

Single square wave : PRO, ADVANCE
Single magnetic input : PRO, ADVANCE
Missing tooth : ADVANCE

Road speed governor tuning:

Linear tuning, limit : PRO, ADV

Of course you can install 2 SMART TUNER's to get the desired signal effectiveness.

For practical tuning of two SMT's you must have two PC's or LABTOPS. Both tuning programs can work on ONE port only. Or you can switch the port cable from one unit to the other!

3.1 DETAILS OF THE DIFFERENT UNITS

This section is most confusing for the newcomer. Do not dwell on it for now. It becomes later clear, once you have "probed" the engine and you now what you need from the SMART TUNER. The following pages explain each unit's functionality in short terms.

COMMON FEATURES:

Analog fuel tuning:
An input voltage in the range from 0-5V can be mapped to an output voltage 0-5V, and limited low and high.

Road speed governor:
A digital input signal (with build in pullup) is converted to an output signal with a different frequency. The output frequency can be limited.

SMT ADVANCE

Has a single ignition input with a switcheable trigger point. The output is a bipolar pulse and 0-12V pulse. Ignition can be retarded and advanced. The unit is suitable for missing tooth applications and normal pickups.

SMT PROFESSIONAL (PRO)

It has a frequency high input and output (0-12v) for fuel tuning. The input trigger point is at 2.5 volts. Its ignition input has a variable trigger point 0.5/4.0V. The single ignition output can be retarded and advanced.

SMT AONI

This unit is for analog fuel timing of one signal only.

4. PROFILED ENGINE INSTALLATION

A WINDOWS SMT engine profile includes:

- Wiring instruction
- Ignition map
- Fuel map
- Global parameter map
- Tune results

The DOS SMT version can load an engine map with the following information:

- Ignition map
- Fuel map
- Global parameter map

A standard engine map is available from the Internet.

WINDOWS SMT:

- Click on the selected engine, and a map appears
- Connect wires as instructed in wiring diagram
- Switch the SMART TUNER on, and establish communication
- Download the selected engine profile
- You may want to calibrate, or check calibration
- Start engine and observe idle.

5. NEW ENGINE INSTALLATION

This section assumes that you have no engine connection diagram, and that you are starting with NOTHING. Here is how to proceed:

1. Find the power wires at your ECU. Confirm that the +12V is switched of by the ignition key. CAUTION: You may be looking at some auxiliary OUTPUT wire, which is later switched off by the ECU.

2. For installation, which requires the roadspeed governor ONLY, proceed to step 20.

3. Find a wire, which leads to the engine and picks up a crank sensor or cam sensor. Put an oscilloscope on it and start the engine. Observe the wave shape. Is it BIPOLAR? (going from negative to positive) or is it a square wave going from 0 to +12 or from 0 to +5 volts?

4. If you have a distributor, then the ECU needs only ONE engine sensor. This signal must have ONE pulse (or square wave) per firing. Find the correct firing edge by monitoring the pickup and the ignition (coil!).

5. If you have wasted spark firing or true sequential firing then you engine must have 2 pickups. One to identify a particular cylinder (one signal per engine turn, or 1 signal per two engine turns), the other with firing information (one signal per firing, or multiple signals per firing). The later signal is important for now. Note the waveshape (Square, bipolar) and the amplitude.

6. If you have a missing tooth wheel (pickup) then count the teeth per turn. Note the wave shape (bipolar!) and the amplitude.

7. Connect the YELLOW wire, IGN1IN, to the firing wire and configure the SMART TUNER global screen. You must show proper RPM indication. For SMT operations see the section applicable to you software. Do not proceed unless you have proper RPM indication.

8. Find a suitable ANALOG deflection signal such as throttle position sensor, manifold pressure sensor, or airflow meter. You are looking for a DC voltage signal less than 5VDC, which varies with the load applied to the engine. Blip the throttle and observe that the signal changes and that the signal stays within the limit of 5VDC. Connect the BROWN wire to this signal.

9. To proceed you need to adapt the deflection (ANALOG, RPM) to your engine. This process is called calibration. See the appropriate sections. It is good enough for now that the cursor moves right to left and up and down when blipping the engine. The fine tuning you can do later.

10. So far you have established that you have an ignition signal and that the maps are operating. In extreme cases you can reduce the maps to ONE dimension, that is to say that one deflection signal is missing. This is not recommended! If you are missing the IGN1IN signal, then you won't be able to have ignition tuning and your fuel tuning is poor. If you are missing the analog deflection, then you can tune ignition and fuel, but poorly.

11. It is now time to find the ANALOG TUNING signal. This is the signal you like to tune or modify, which should when changed, alter the fuel/air mixture of your engine. Again you are looking for airflow meter, AMP sensor. In extreme cases you may like to use the LAMBDA sensor, but this is not recommended, unless you like to tune idle and light cruising conditions. The LAMBDA loop is ineffective at full throttle. Check the signal with an oscilloscope and verify that it is a DC voltage, and that it is varying when you blip the engine. It must stay below the maximum allowed 5VDC. If you disconnect this wire while the engine idles, it should go rich. Connect this wire to the BLUE SMART TUNER.

12. If you find a frequency signal (airflow or AMP) then connect it to the BLUE/WHITE wire of the SMART TUNER. This wire is only available on the SMART TUNER PRO!

13. At present you have MAP control and you have connected all control signals but you are NOT controlling the engine. The SMART TUNER outputs are open. It is recommended to connect the FUEL (ANALOG_OUT, VIOLET) signal first and confirm proper operation. Cut the ECU wire AFTER the point where the BLUE wire is connected (ECU side) and connect it to the VIOLET wire. The analog signal from the engine bay runs now through the SMART TUNER, where it will be modified. You have to perform an analog calibration, which is explained somewhere else. Check relay switch connections!

14. If you have a FREQUENCY signal, then cut the ECU wire after the BLUE/WHITE connection (ECU side) and connect it to the BLUE/BLACK wire. The frequency signal from the engine bay runs now through the SMART TUNER before going to the ECU. Check relay switch connections! The frequency signal requires no calibration.

15. It is now possible to tune fuel under map control. The tuning process is explained somewhere else in this manual. It normally involves a device to measure the exhaust gas (Air/fuel ratio or CO) and a device to measure the power of the engine (Dyno, or Acceleration).

16. Before proceeding to connect the ignition, it is important to confirm which SMART TUNER output signal is the most suitable. Connect a scope to the input (IGN1IN, YELLOW wire) and note wave shape, frequency and amplitude. Then connect the scope to the following signals and choose one, which is the most suitable. The frequency of both signals MUST be the same, but voltage and shape may differ.

IGN_BIPOLAR_OUT	WHITE
IGN_SQUARE_OUT	PINK
IGN_2_OUT	BLACK/RED

Some SMART TUNER versions have not all these outputs.

17. If you have found a suitable output, then confirm that it is at the same place as the FIRING edge of the input signal. If not change the setup in the global SMT screen until it is. At this point you are concerned with 1-3 degrees variation.

18. Cut the wire to the ECU after the YELLOW wire joint and connect it to one of the SMART TUNER output wires. Check relay connection! The signal from the engine bay runs now through the SMART TUNER and then to the ECU. Start the engine and observe that it idles. You can now tune ignition. The tuning process is explained somewhere else in this manual.

19. For engines with dual (linked) ignition signals proceed the same way, but TEE in the BLACK/BROWN wire of the SMART TUNER first. A linked signal means that if you tune one only, the ECU notices it and stops, because the relationship between the two signals is upset.

20. Road speed governor:

    Find a wire, which comes from the drive train or gearbox. Then cut it and insert the SMART TUNER.

ROAD_IN	ORANGE	connect to wire from drive train
ROAD_OUT	GREEN	connect to wire from ECU

    Before operating your engine, set the road speed adjusts to 100 %, which means no adjustment. Drive your car and observe that everything is functional. Then change the road speed adjusts to 80% and observe that the governor limit is 20% higher.

21. If you like to make use of the MAP switching facility, then connect a toggle switch to the GREY wire and ground.

6. RPM DEFLECTION - ALL UNITS

The RPM DEFLECTION is derived from the IG1IN (YELLOW wire). The same input is also used for the ignition output. It is recommended to start an installation by TEEING the yellow wire in to the ignition signal and get the following points eliminated:

A) TRIGGER LEVEL

The input trigger point can be changed from 0.5 to 4.0 volts from within the GLOBAL screen. A magnetic pickup should be set to 0.5Volts, where an optical to hall-sensor requires a 4-volt trigger point.

Magnetic input:	0	4.0 volts
Magnetic input:	1	0.5 volts

B) Set CYLINDER

to the correct value: 3,4,5,8,10,12

C) Set MISSING TOOTH METHOD:

0	continuous pulses
1	missing tooth method

D) Set TEETH PER TURN:

as counted, including the missing tooth

E) Set TEETH PER FIRING:

as counted

Set INPUT POLARITY:

Check with Scope

The WINDOWS version of SMT stores multiple engine profiles. If your engine is in the library, then you need not to set the individual items.
SEE: DOS or WINDOWS OPERATION

Once the global screen is configured, then the RPM should indicate correctly on either SMT program. If not, check the signal connection with a scope while the engine idles, and check the global parameters.

DO NOT PROCEED UNLESS THE RPM INDICATES CORRECTLY!

The SMART TUNER allows 16 rpm sites. The actual sites can be chosen by the operator according to the tuning objective. The site distribution is either:

a) Manual selected
b) Linear selected
c) Unlinear selected

The DOS version of SMT assumes linear selection. For details of RPM site selection see: SMT OPERATION, in either DOS or WINDOWS. The outcome of the selection is that the engine can be tuned over 16 sites, which span the desirable RPM tuning range. The WINDOWS SMT version has engine profiles (maps) where the selection has been made already, and is loaded automatically when an engine is selected.

Once the RPM site selection is complete, rev the engine and observe that the cursor moves up and down correctly.

This completes the RPM DEFLECTION set up. Ofcourse you can change particular site RPM's with the WINDOWS SMT version to suit your own style and ideas.

SPECIAL RPM IDLE SITE (IGINITION)

The bottom row of the ignition is special. Any number entered into it will be ignored, and a zero is effective. The ignition circuit is effectively disabled, and no tuning is allowed. The ignition signal on IG1IN (Yellow) is copied to the output as follows:

Missing tooth: ∅

The input signal is copied to the output

Missing tooth: 1

The selected input edge is copied as a pulse to the POUT (grey/black) and the BOUT (pink) outputs.

Note: The fuel tuning is effective in RPM row zero (idle).

This particular feature is recommended for "disabling" the ignition output during testing.

7. ANALOG DEFLECTION

The analog deflection input (ANALOG_DEFL, BROWN wire) is used to select a value from the maps. It can be connected to:

- Throttle switch
- Manifold pressure transducer
- Airflow meter
- Any other voltage source in the range from 0 to 5 volts!

Important is that the signal changes while the engines operates at the points where tuning is desirable. If no signal can be found which is suitable, then must provide such signal by mounting extra hardware to the engine:

- Throttle potentiometer
- AMP sensor

The feeding of these extra components, and the connections, are left to the experts. Needles to say, they have to produce a voltage variation in the range from 0 to 5VDC which changes while the engine operates at the points where engine tuning is desirable.

A voltage change of 1 volt is enough, the more the better. The exact points of map sites can be calibrated:

a) Manual
b) Linear
c) Unlinear

The DOS version assumes linear points. That is to say is linearises the 7 map sites between the AS nnn and AE nnn points.

For details of the ANALOG_DEFLECTION operation, see: SMT OPERATIONS in the SMT – User Manual.

The details vary between the DOS version and the WINDOWS version.

8. ROAD SPEED GOVERNOR

The input (SPEED_IN, ORANGE) wire should be connected to the speed source, which comes from the gearbox or diff (drive train). The output (SPEED_OUT, GREEN wire must be connected to the ECU.

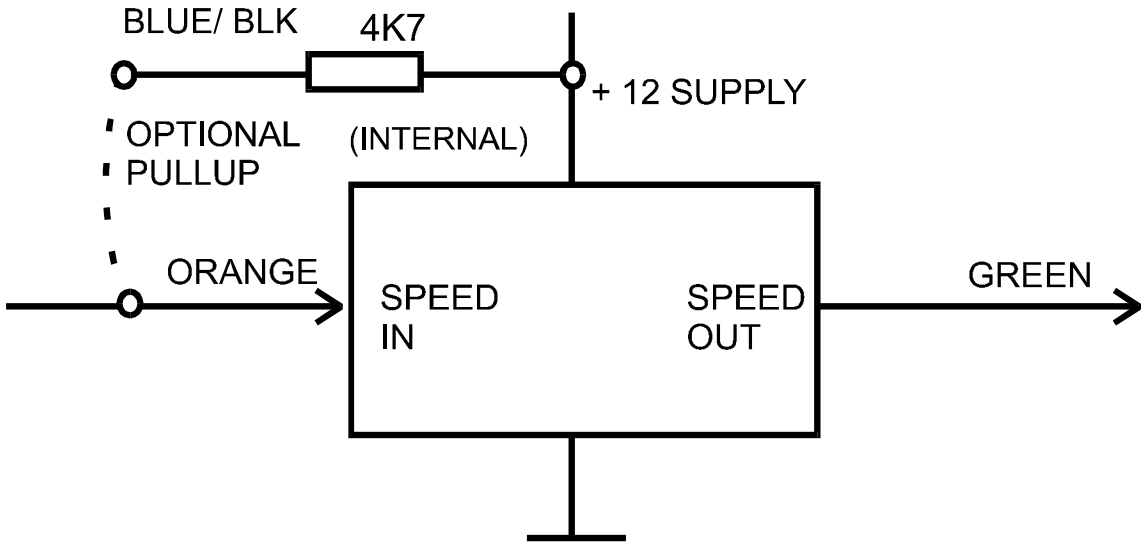
This function is active without any other signal connected, except GND (black) and +12(red).

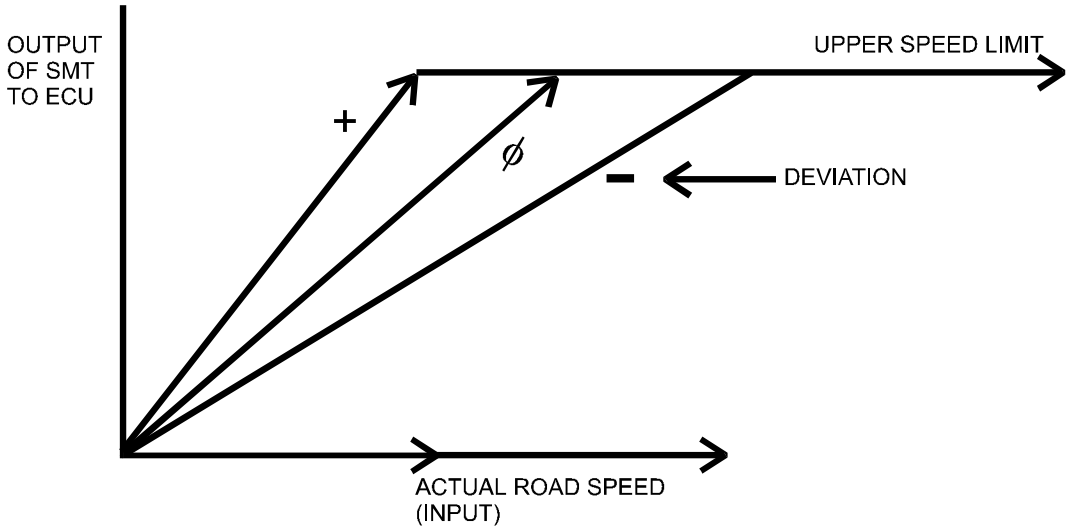
The range of the speed activation is controlled by: ROAD SPEED RANGE.

The maximum input (and output) frequency is:

Road speed range: 0	(low speed)	Maximum:	5	kHz
Road speed range: 1	(high speed)	Maximum:	10	kHz

If the input frequency is very low, then the unit duplicates the input frequency WITHOUT any adjustments.





The effect of the upper speed limit (global screen) can best be seen on the above graph. The Roadspeed adjust changes the slope (input to output relationship), where the upper speed limit restricts the high road speed from reaching the ECU. The setting of the upper speed limit can be done by the:

SL command

from DOS or via the SMTWIN Software.

DOS SS COMMAND

This can only be used when the car is travelling at highspeed, close to the ECU governor speed. Press SS, and the present measured speed is programmed into the SMT.

9. ANALOG MODIFIER INPUT/OUTPUT FOR FUEL ADJUSTMENT

The analog input must be a signal between 0 to 5VDC. This signal is modified as follows:

ANALOG_OUT = (ANALOG_IN ± ANALOG_ZERO ± MAP) limited to upper/lower

The following connections apply:

ANALOG_IN: BLUE wire
ANALOG_OUT: VIOLET wire

The other signals are parameters:

ANALOG_ZERO: Global screen, +- 99 max.
MAP: The site on the fuel map, selected by RPM and ANALOG Deflection

DEFLECTION LIMITS: Global screen, 0-5VDC

This signal works once power is connected. Ofcourse, the MAP value from the site selected by RPM and ANALOG_DEFLECTION applies.

ANALOG_ZERO CALIBRATION:

This is necessary to eliminate the electronic in-accuracy. It can also be used to introduce a global offset to ALL map points (in the same way as typing the same number in to every map point!).

It is important to perform the following calibration in order to check out the system.

1. Connect the ANALOG_IN to the source and the ANALOG_OUT to the ECU.
2. Connect the power of the SMART TUNER
3. Connect a PC or LABTOP. Run the SMT program.
4. Switch the car power on, but don't start the engine.

5. Connect a digital voltmeter (DC) between the ANALOG_IN and ANALOG_OUT
6. The reading should be very small, less than 0.2 volts
7. If not, you may have a wiring problem, or the loading (ECU) is too high.
8. Try to adjust the multimeter reading to zero by typing a number in to the global screen: Fuel zero calibration
9. The number should be very small, in the range from -10 to +10.
10. If not, you may have a wiring problem, or the loading (ECU) is too high.
11. If the loading is bad, then you have NO CHOICE but to terminate the project. You cannot adjust fuel!

10. IGNITION RETARD & ADVANCE

This is the most complex and time consuming part. If not absolutely necessary and required, it should be left alone. Engines with complex knock sensor adjustments may not need any ignition adjustment, and may even "counter adjust" your tuning efforts. But most professional tuners like to work on the ignition, and if the fuel is kept at a high octane, power can be gained from adjusting otherwise standard ignition.

SO - HERE IT IS!

First choose a unit, which suits your application:

MISSING TOOTH PICKUP: ADVANCE

Multiple teeth per engine turn, one or two teeth missing. The missing teeth Indicate a cylinder pair.

SINGLE PICKUP PER FIRING: PRO

One pickup pulse (magnetic or hall) for each firing. Engines with a distributor only require one pickup, others have a second pickup to identify a cylinder pair. For complex signals the following applies:

Once a unit has been chosen, the correct output of the SMT must be identified:

ADVANCE	POUT:a pulse from 0 to 12 volts BOUT: a BIPOLAR output, first going negative (5Volts) and then positive (4 volts).
PRO	IG1OUT: A square wave, 0-12 Volts, with 50/50 duty cycle. One EDGE signifies the FIRING position.

ALL units have a special feature to make the choice of output signal easy:

THE INPUT IS COPIED TO THE OUTPUT WHILE THE SMT IS IN THE LOWEST RPM RANGE!

To use the feature set the lowest RPM step relative high (e.g. RS 3000), which means that the SMT will do NOTHING until you have more than 3000 RPM. Then take the output of the SMT and connect it to the input of the ECU. You may like to use the "SWITCH OVER" technique described somewhere else. The car must start and run! If not, then the SMT output is not suitable for the ECU input. In desperation you may use a capacitor (0.1uF) in-between the input and output, to choose the other output if available.

If you can't get is working, then you can't adjust ignition!

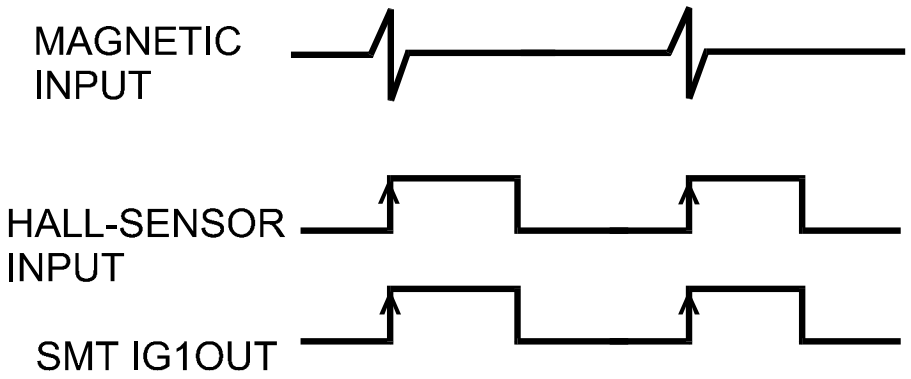
The next step is to lower the RPM scale and check if the engine runs. Type RS 1000 and tease the engine above 1000 RPM. If it stops, or changes drastically, then the input polarity (F3, upper right) must be changed.

If you can't get it working, then you can't adjust ignition!

If it works, then you have succeeded. Make sure that all ignition map points are zero (CI, followed by DL) and tease the engine to the full rpm range. It should sound and behave as if the SMT were not present. If you have a timing light, then confirm that the ignition point has not shifted. A ONE degree shift is acceptable at higher RPM's.

You can now tune ignition!

10.1 IGNITION ADVANCE & RETARD (NON-MISSING TOOTH METHOD, MISSING TOOTH=0) PRO



In this mode a single ignition pulse train is advanced or retarded. The input is on IGN1IN (brown wire), which also serves as the RPM deflection input. The trigger level of this input can be shifted:

BIPOLAR INPUT=0:	4 Volts
BIPOLAR INPUT=1:	0.5 Volts

Once the input triggers with a signal, then the RPM cursor will move, provided that the RPM scale has been set up. Depending on the software used, the RPM steps can be linear, manual, or unlinear selected between the START RPM and STOP RPM parameters. For details see RPM DEFLECTION.

For setting up the unit, it is advised FIRST to TEE-IN the IGN1IN signal and set up the RPM scale. Observe that the RPM are correctly indicated and that the cursor moves to the specified slot when revving the engine. DO NOT PROCEED UNTIL THIS IS CORRECT. For details see RPM DEFLECTION.

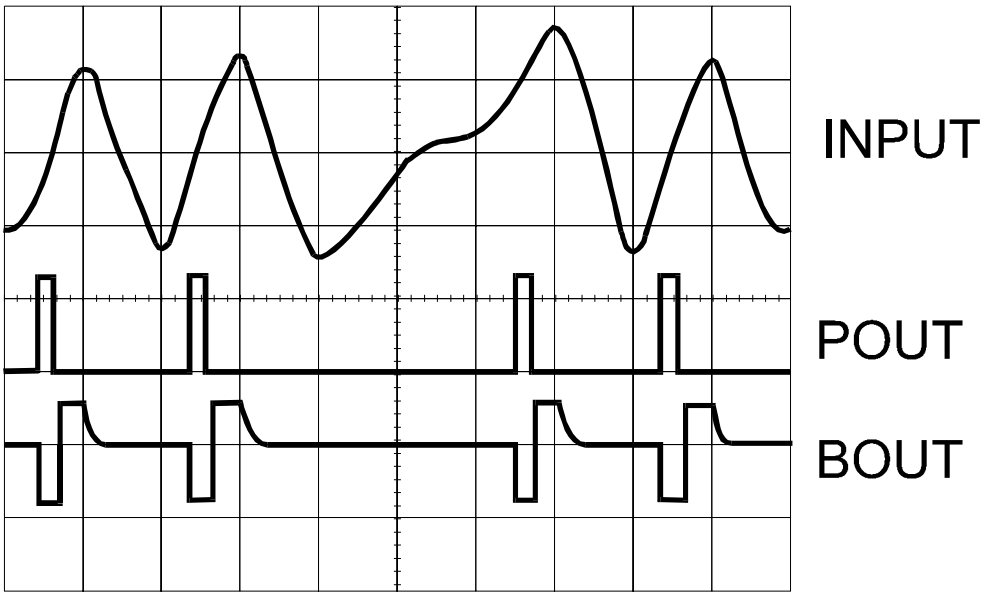
Once the RPM indications are correct, the outputs can be analyzed.

10.2 MISSING TOOTH METHOD ADV

In this mode a single pulse train is advanced or retarded. The pulse train comes from a 60 teeth (58 and two missing) or a 38 teeth (37, one missing) pickup. The input trigger level can be shifted as before. Once the input triggers, then the rpm cursor should move, and the rpm should be indicated correctly. Check:

Cylinders
Teeth per turn
Teeth per firing

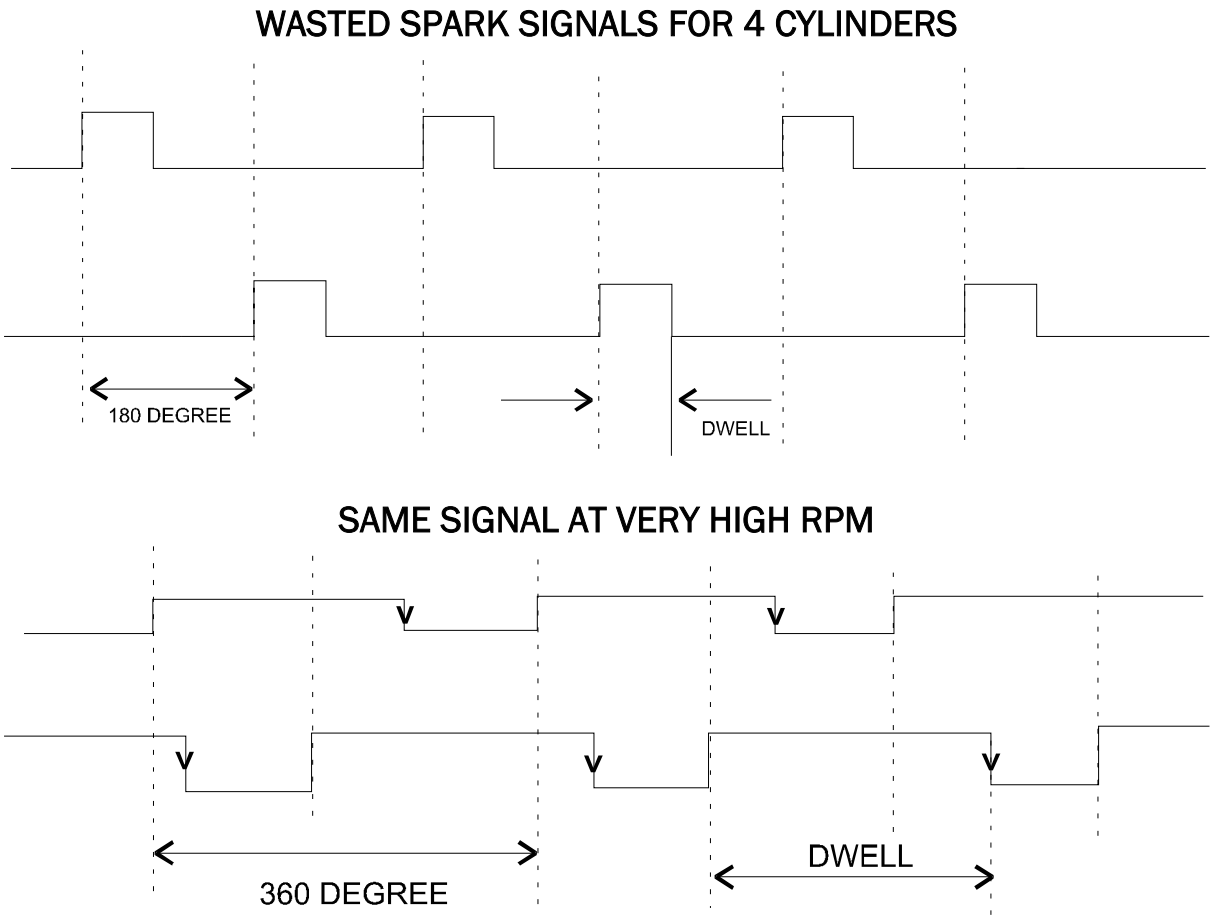
It is advisable to first TEE-IN the IG1IN signal, or use the SWITCH OVER technique. Then you can see the sensor pulses and the SMT output pulses on a dual trace oscilloscope, and compare them.



Note that both outputs are "DELAYED" from the input trigger point by a circuit delay, and that the input trigger polarity must be correct in order to minimize the delay. Ofcourse, the circuit delay can be eliminated by ADVANCING the complete ignition map. It is also possible to reverse the input signal polarity by reversing the pickup wires. The SMT triggers on positive signals ONLY, but the level is adjustable from 0.5 to 4 volts.

10.3 INTERLACED SIGNAL ADV

This operation mode applies to 4 cylinder engines only, where the ECU ignition output wasted spark signals are modified. This method is only available in units shipped after 30/1/2001 and requires the ADV1 software.



This mode of operation requires:

SMT-ADV(1) Version 15

Cylinders:	4
Ignition input polarity:	0/1 sample above = 0
Missing tooth method:	Ø
Interlaced:	1

The word “interlaced” refers to the way both ignition signals are related to each other. At very low RPM (RPM position zero) the SMT copies the input(s) to the output(s). All other positions can be retarded or advanced by the map entry.

11. FREQUENCY MODIFIER INPUT/OUTPUT FOR FUEL ADJUST

Some engine parameters are measured via a frequency conversion. That is to say a frequency signal comes from the engine, and it contains information as to the airflow, temperature or manifold pressure. With a change in the engine parameter, the frequency changes. To tune this parameter a PRO unit must be used, which has a frequency input and a mappable frequency output. The input (and output) frequency must be in the range from:

61 Hz to 4000 Hz

Frequencies outside this range are limited to the range! With a map value of zero, the input frequency is copied to the output.

Input:	WHITE/RED	wire
Output:	WHITE/BLUE	wire

The input responds to 12V signals (0-12V swing) and has a 4K7 pull-up to 12V. The output is a transistor collector, with a pull-up of 4K7 to 12V. The map deflection of the FUEL (FREQUENCY) map is done conventional. You need a RPM DEFLECTION and an ANALOG DEFLECTION input:

RPM DEFLECTION input (and ignition input):	YELLOW wire
ANALOG DEFLECTION:	BROWN wire

With these wires connected, and the power to the unit, the cursor should move around the fuel map and pick up a fuel modify value (map value). This value can be positive, zero, or negative.

POSITIVE map values:	Increase the frequency
ZERO:	does nothing
NEGATIVE map values:	Decrease the frequency

In order to affect NO mapping, which means NO frequency change between the input and output, zeros should be entered.

Any map value other than zero changes the frequency (the output frequency differs from the input) by a small amount. The actual frequency change is:

Freq.Out = Freq.in + (Freq.In * map.value)/128

This works out to about 0.78% frequency change per step of one!

If this change is too much, then a LOW FREQUENCY deviation can be activated, which is located on the GLOBAL screen. With the LOW FREQUENCY option set, the frequency change is:

Freq.Out = Freq.in + (Freq.In * map.value)/512

This works out to 0.19% frequency change per step! The actual frequency (and the change) is tuned with the engine running. The effect is has on the engine is monitored, but the actual frequency is not.

12. WIRING - ALL UNITS

Product	PRO	ADV	AONI
Signal			
GND	Black	Black	Black
+12	Red	Red	Red
Ana_defl	brown	brown	brown
Ig1in (+defl)	yellow	yellow	yellow
Road_in	orange	orange	
Road_out	green	green	
Analog_in	blue	blue	blue
Analog_out	violet	violet	violet
MAP	grey	grey	grey
Ig1out	white	white	
Ign_bout	-	pink	
Ign_pout	-	grey/black	
Ig2in,Freqin	white/red	white/red	
Ig2out,Freqout	white/blue	white/blue	
Pullup 4k7	blue/black	blue/black	
IG1P			
IG2P			
BOP1			

Note: The ADV & SUPER use the same hardware, but different software. The wires in brackets may be provided, but have no function.

Note: The AONI does not use the ignition map.

13. SPECIFICATIONS:

POWER	:	6 to 15VDC, approx. 0.03 Amps
Temperature	:	-10 to +60 degrees
Size	:	77 x 77 mm
Weight	:	?????

ANALOG_DEFL INPUT

- 10K impedance, 0.1 uF
- Protected above 5 volts
- Range 0-5 volts

ANALOG_MOD INPUT

- 100K impedance, 0.1uF
- Range 0-5 volts
- Protected

ANALOG_MOD OUTPUT

- 2k2, 0,1uF

MAP SWITCHING INPUT 10K

impedance pull-up, map A: open
map B: shorted to ground

RS232 GND, RX, TX

IG1IN, IG2IN: 4K7 pull-up to 12V
TRIGGER LEVEL: 0.5 or 4.0 volts, software selectable
Trigger delay: 0.02 ms
Filtered

SPEED_IN: 4K7 pull-up to 12V
Filtered
Protected above 5V
Trigger level approx. 2.5 volts

SPEED_OUT, IG2OUT, IG1OUT:

Transistor collector output
Pull-up 4K7 to 12V
Sink current: max 20mA

POUT:

Square wave pulse output
Impedance 2k2
0-12V swing
0.6ms at slow RPM
0.05ms at fast RPM

BOUT

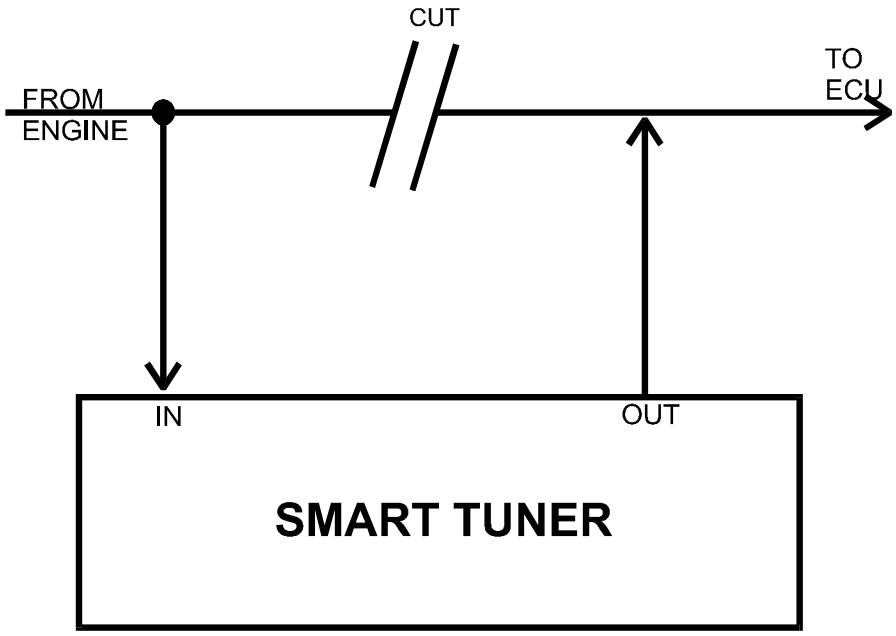
Bipolar output
Impedance 2k2
+-5 volt pulses
approx. 0.3ms positive, 0.3ms negative

PULLUP

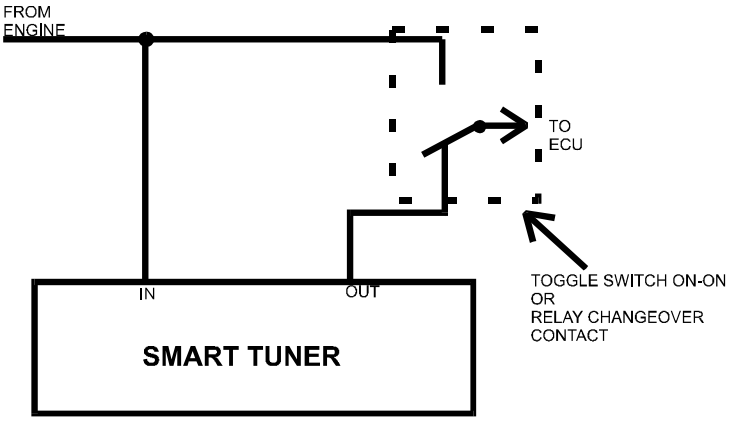
4k7 to 12V

14. RELAY SWITCHES – ALL UNITS

Some signals must be routed “through” the SMART TUNER so that they can be tuned. This involves “cutting” a wire. In order to check the signal while running the engine, a simple switchover arrangement is advised.



CONVENTIONAL "CUT AND ROUTE THROUGH"



BETTER: RELAY SWITCH OVER

15. KEYWORDS - ALL UNITS

Throughout this manual certain keywords are used. This section explains them.

POWER:

This means +12V from the battery and GROUND, chassis. The black wire goes to the chassis, or the ground signal in the ECU harness. The red wire goes to a 12V signal, which is switched from the ignition key.

RPM (DEFLECTION):

This signal moves the map cursor up and down. It is also the IGNITION #1 input signal.

ANALOG DEFLECTION:

This signal moves the map cursor right and left.

IGNITION INPUT #1 (IG1IN):

This signal is the same as the RPM DEFLECTION. Its corresponding output is the IGNITION OUTPUT (IG1OUT).

IGNITION INPUT #2 (IG2IN):

This signal is used for 2 simultaneous tuning of ignition systems. Only used in special applications.

ANALOG INPUT:

A signal in the range from 0 to 5V, which indicates the airflow, throttle or manifold temperature.

ANALOG OUTPUT:

The signal resulting from the ANALOG INPUT, but mapped.

MAP:

128 values, one of which is selected by the deflection inputs. This selected map value is then applied to one of the inputs to produce a modified output.

MAP VALUE:

One particular value within a map.

ECU:

This is the standard Engine control unit in your car.

FREQUENCY:

A signal generated by the airflow meter, or manifold pressure sensor. It tells the ECU what the measured sensor value is. The frequency changes with changing engine parameters.

PULSE OUTPUT:

A signal from 0 to +12V, short of duration.

BIPOLAR OUTPUT:

A signal which "swings" from zero to positive, then to negative, and then returns to zero again.

ROAD SPEED:

Not a RPM signal, but a signal, which is generated from the drive train. It describes the ROAD SPEED the car is traveling.

GOVENOR:

Some cars have a road speed governor, which restricts the max speed the car is ALLOWED to travel. The same signal may be used to switch gears in automatic transmissions.

RETARD/ADVANCE:

Applies to ignition. A positive number ADVANCES, a negative number RETARDS. The maximum retard and advance of a signal depends on the unit and the pickup system.

FUEL TUNING:

A method, where by you change a signal from the engine to the ECU, and the ECU changes the fuel.

IGNITION TUNING:

A method where you retard or advance a signal from the engine to the ECU, and then the ignition retards or advances.

MAPPING:

A process, normally done on a dyno, where the engine is operated at a specific point (throttle) under load, and the fuel and ignition is adjusted to achieve the desired effect. Not all 128 map points have to be mapped!

MAP SWITCH:

A switch on the dashboard, which allows you to select ONE of two engine maps. The maps must have been "updated" or loaded before you can use them. The factory ships the units "ZERO" maps, which do nothing.

LINKED IGNITION:

This is normally indicated by two crank or cam sensors, sometimes next to each other. It means that you can't change one signal without changing the other, otherwise the ECU will stop the engine.

RPM STEPS:

The SMART-TUNER can work on any RPM graduation. That is to say that the 16 RPM STEPS are selectable.

ANALOG STEPS:

The 8 analog deflection steps are selectable.