

SMT-UNI 4 DEVELOPERS MANUAL

**Perfect
Power**



SMART TUNER

Product Marketing

by:

Digital

TECHNOLOGY (pty) Ltd

SMT UNI 4 DEVELOPERS MANUAL

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1. FEATURES

The UNIVERSAL SMART TUNER (SMT-UNI) Version 4 is the result of combining the:

SMT-PRO
SMT-ADV
SMT-SUPER

and adding some unique performance, which result in the following features:

- Pickup sensing for magnetic and high level signals
- Missing tooth pickup
- Single trigger inputs per firing
- Multiple trigger inputs per firing
- Automatic pulse output duration compensation
- Analog fuel tuning, with high and low limits
- Frequency fuel tuning
- Extra proportional injector activation
- Road speed governor with proportional adjust and limits
- Two ignition inputs and outputs
- Interlaced operation (for 4 cylinder wasted spark)
- Small size
- Protection on all inputs and outputs
- RS232 tuning in DOS and WINDOWS
- Polarity switching for inputs and outputs
- Two maps sets
- Max rpm recordings
- Self test via supplied program
- PWM fuel modification

All of the above features are not available simultaneously, but some features are grouped together, and can be selected with an OPERATING MODE. See: next!

2. OPERATING MODES

The SMT-UNIVERSAL (UNI) Version 4 has all required operations combined in to one unit. The specific operation is selected by specifying a MODE. The mode is a number, which tells the unit to perform a specific task.

The analog fuel operation is INCLUDED in every mode. An analog signal is modified (up or down!) in order to achieve different fuel setting. Hence the name: ANALOG FUEL. The analog fuel is also used to activate the injector output. Therefore, analog fuel and injector activation is included in every mode.

At present, the following modes can be specified:

MODE=1 Missing tooth operation

The pickup is from a multi-tooth wheel, with one or two teeth missing. The output signal can be advanced or retarded to a max. of 2 teeth.

MODE=10 Single ignition advance and retard + frequency fuel

The ignition pickup is from a single sensor, magnetic or optical, which can be advanced or retarded. The signal must be "uniform", and it must repeat every engine turn (or every two turns). Multiple "teeth" or trigger points per firing are allowed. The frequency signal of an airflow meter can be tuned for fuel.

MODE=11 Single ignition advance and retard + road speed governor

The ignition pickup is from a single sensor, magnetic or optical, which can be advanced or retarded. The signal must be "uniform", and it must repeat every engine turn (or every two turns). Multiple "teeth" or trigger points per firing are allowed. The road speed governor allows to move gear-switching points and remove (or shift) the road speed governor.

MODE=12 Two ignition advance and retard

Both ignition inputs can be advanced or retarded. The RPM is derived from the CB1 (RPM Deflection) input, and the ignition advance and retard timing is calculated from it, and then applied to BOTH ignition outputs.

One of the preceding modes must be specified in the GLOBAL SCREEN (F3). Details of the various UNI functions are provided in the following pages.

MODE=13 Single ignition advance and retard + PWM fuel

The ignition pickup is from a single sensor, magnetic or optical, which can be advanced or retarded. Same as mode=10 or mode=11. The duty cycle of a frequency signal (CAM or boost control) can be controlled from the fuel map.

3. GENERAL CONNECTIONS

POWER

The SMT is powered from a "switched" +12V (+8 to +16V) battery. It takes, depending on the operating mode, 0.02 - 0.1 Amps.

Ground, Chassis, -12V:	Black	Pin 1
+Battery, +12V:	Red	Pin 10

RS232 CONNECTIONS

Once the SMT has power, the RS232 port to the computer (PC) or laptop is working. A three pin connector provides:

Ground, Chassis, -12V:	Pin 1
UNI RX (input):	Pin 2
UNI TX (output):	Pin 3

The protocol to the unit is propriety, and the unit will only respond to the SMT DOS or the SMT WINDOWS program, which can be downloaded from the PERFECTPOWER.COM Website.

A connection cable, SMT to D9 PC, is available from the manufacturer.

4. MAP DEFLECTION SIGNALS:

The SMT-UNI Version 4 has two maps, one for fuel and one for ignition. Each map holds 128 "sites", organized in an 8 (throttle, load) by 16 (RPM) matrix. In order to select one of the map points, and use it for the modification of the fuel and ignition, the DEFLECTION signal inputs are used. The SMT-UNI Version 4 has a:

ANALOG DEFLECTION INPUT:	BROWN	Pin 7
IGN1IN DEFLECTION INPUT:	YELLOW	Pin 8

Analog deflection:

The signal input range is from 0 to +5 Volts. The map deflection can be "calibrated" to respond to any portion of the input range. See: DOS or WINDOWS manuals. The analog deflection is normally connected to the throttle or the manifold pressure sensor. It can be connected to an ANALOG airflow meter, which gives a DC voltage out proportional to the airflow. Important is that the analog deflection input somehow shows the engine "loading". If the analog deflection is not used, then it should be connected to ground.

RPM deflection:

This input serves also as the IG1IN (Ignition #1 input). It must be connected to a signal, which repeats every 360 degrees. The pickup level can be specified on the global (F3) screen:

Magnetic pickup: 0	0.5 volts
Magnetic pickup: 1	2.5 volts

In addition, the input polarity of the signal can be specified as the EDGE at which the SMT triggers.

Input polarity: 0 zero	Negative edge, from positive to zero
Input polarity: 1	Positive edge, from zero to positive

The RPM deflection input needs a signal, which repeats at least once per firing, except when using "Interlaced mode". See: INTERLACED INPUT AND OUTPUTS. When using multiple trigger signals per firing, then the

TEETH PER FIRING: x

must be set to it. Everything is set correctly when the RPM are indicated correctly!

The RPM range can be set (calibrated) to span the desired tuning range. The DOS program sets it linearly, the WINDOWS program sets it the way you specify it. SEE: DOS and WINDOWS manuals.

The lowest RPM position is not used. Instead the output is a copy of the input. The polarity specifications apply in RPM position zero!

5. ANALOG FUEL TUNING

This function is included in every SMT mode. It also includes the EXTERNAL INJECTOR ACTIVATION. SEE: Next section.

The analog input range is 0 to +5 Volts, corresponding to the same output range. Higher signals cannot be accommodated without external circuitry. The connections are:

ANALOG INPUT:	BLUE	PIN 6
ANALOG OUTPUT :	VIOLET	PIN 15

The analog output is derived:

ANALOG OUTPUT = ANALOG INPUT +/- OFFSET +/- FUEL MAP VALUE

The offset is specified on the global (F3) screen, and the fuel map value is the value selected by the ANALOG and RPM DEFLECTION signals.

The output can be limited by the two global (F3) screen parameters:

UPPER ANALOG LIMIT	:
LOWER ANALOG LIMIT	:

The entry is in volts!

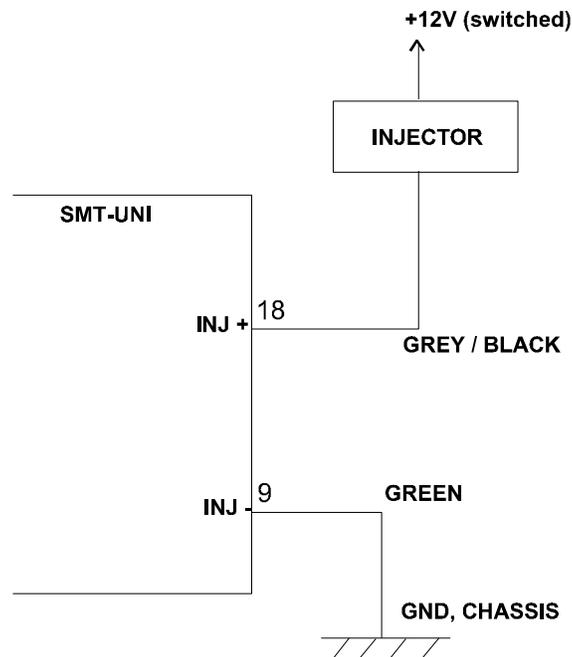
6. EXTERNAL INJECTOR ACTIVATION

The SMT-UNI Version 5 has one injector output, which can drive one to eight injectors of 16ohms. The total injector current is limited to 7 Amps, and an optional heatsink must be installed on the cooling tab (if the injector current is too high). However, since the extra injector(s) is not activated continuously, it is advisable to measure (touch!) the cooling tap during injector activation, and if touchable, no heatsink is required. The injector output driver is temperature protected, and will switch "OFF" if it gets approx. 100 degree C.

The outputs are:

+INJ	Grey/Black	Pin	18
-INJ	Green	Pin	9

The following diagram explains the connection:



Note: The INJ – Connection draws the injector current of 1-7 Amps. This wire should be connected to the chassis or battery – away from the SMT-UNI GND (Black) wire.

The injector output is activated when the fuel map entry EXCEEDS the

Fuel limit (inject above):

parameter on the global (F3) screen. This means the injector is open proportional above the FUEL LIMIT with the difference. The injector open time or the FUEL LIMIT does NOT affect the analog output.

The injector stays open for:

Injector open time = (fuel modifier - FUEL LIMIT) * 0.1 ms

Therefore, the max open time is approx. 9.9ms for a fuel modifier of 99 and a FUEL LIMIT = 0. The injector output is activated every firing.

In the missing tooth method, a maximum of 8 cylinders is allowed. That is to say that the injector output is activated up to 4 times per engine turn.

The analog output UPPER and LOWER limits effect the analog output only as follows:

Analog output = input +/- offset +/- modifier limited to UPPER and LOWER analog limits. SEE: ANALOG FUEL TUNING

7. FREQUENCY FUEL TUNING

The UNI MODE = 10 activates a single ignition signal retard/advance AND the FREQUENCY FUEL modification. In this mode the frequency on the IG2IN is copied to the IG2OUT with the fuel modification applied. This mode of fuel tuning is needed for frequency airflow meters, which output a frequency signal proportional to the airflow.

The SMT UNIVERSAL Version 4 has the following operating range:

High freq or speed: 0 (=Low)
10Hz to 3300Hz (3.3kHz)

High freq or speed: 1 (=High)
80Hz to 18000Hz (18kHz)

The active parameters are:

Cylinders	:	sets rpm of fuel map
Teeth per firing	:	as above
Fuel map	:	
Frequency deviation	:	changes the IMPORTANCE of the fuel mod

Note:

The UNIVERSAL SMT Version 4 does not require ignition input or analog deflection, except to select a fuel map modification value. The analog fuel tuning output is active.

Frequency input	:	White / Red	Pin 5
Frequency output	:	White / Blue	Pin 14

Note: A pull-up (blue / black, pin 11/12) may be used on the input.

Note: A positive number increases the frequency and the fuel.

8. ONE IGNITION INPUT SIGNAL

In UNI MODE=10, 11, and 12 and 13.

IG1IN	YELLOW	Pin	8
IG1OUT	WHITE	Pin	17

are the prime ignition (CB1) input and output signals. The input trigger level (SEE: RPM DEFLECTION) and input and output polarity can be specified.

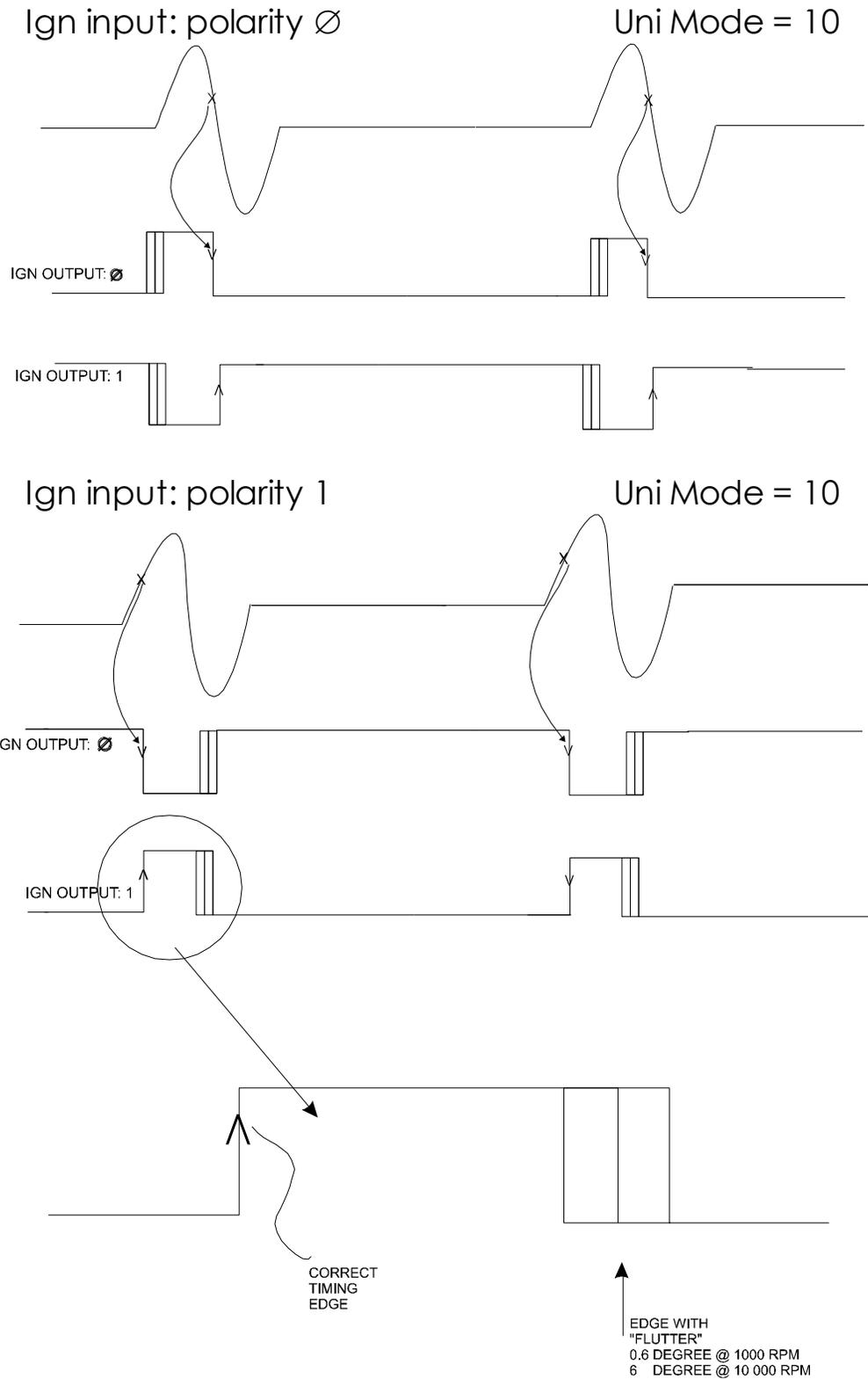
The IG1IN signal serves as a map deflection input, and it requires that the signal repeats every engine turn.

The output is affected by:

- Cylinders:
- Teeth per firing:
- Input polarity
- Output polarity
- Interlaced

At RPM position zero (bottom map row) the output signal is copied from the input, and no timing is applied. This allows the changing of input and output polarity, until the engine starts and runs. At this point the RPM indication should be correct.

The BIPOLAR (MAGN) INP parameter is active, but does not change the output drastically, it only changes the input trigger level.



It is obviously from the above that an input and output edge combination is chosen which does not have the "flutter" at the firing edge (trigger edge).

9. TWO IGNITION INPUT SIGNALS

The second ignition input and output is available in UNI MODE=12. For the first ignition input and output, SEE: ONE IGNITION...

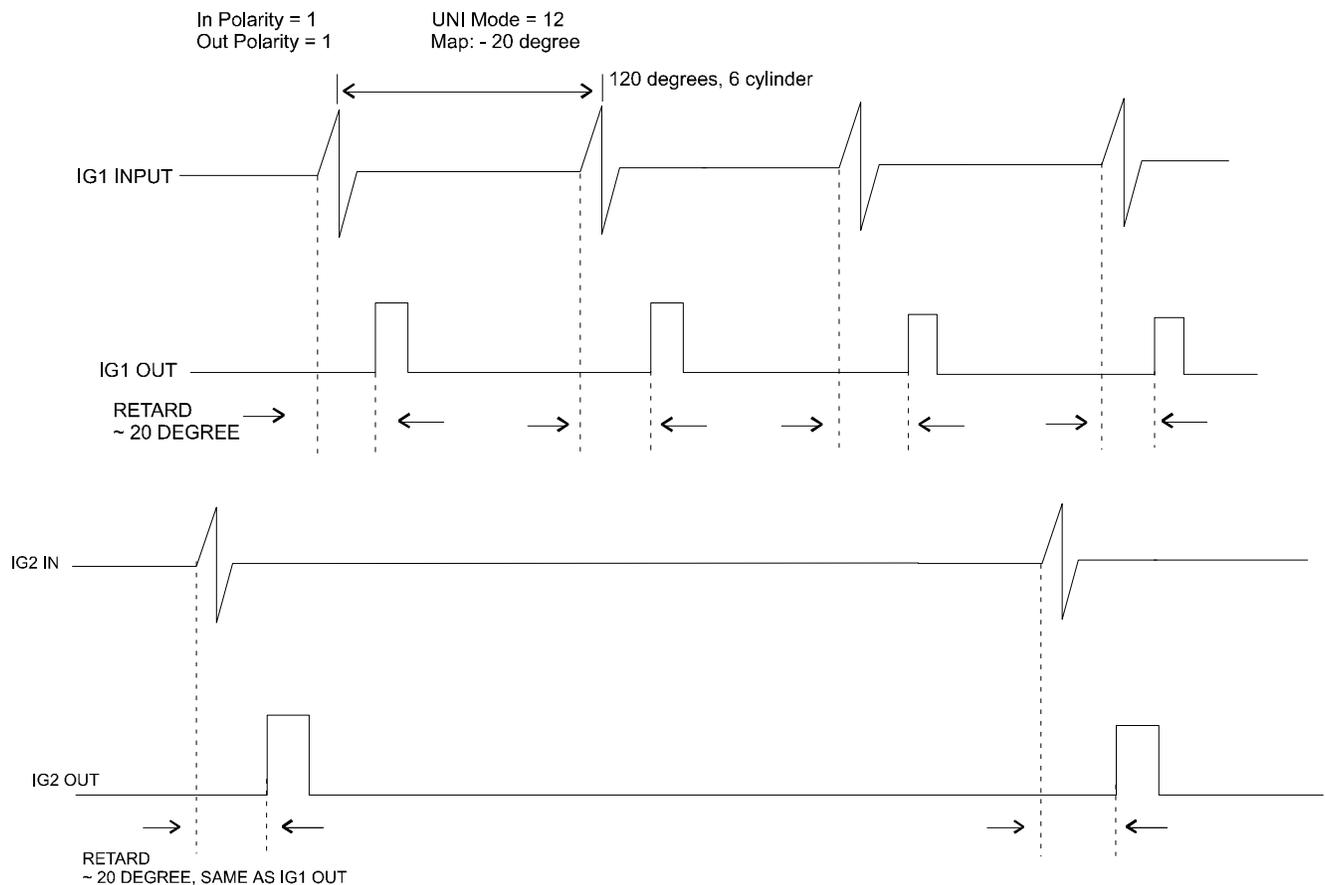
The connections are:

IG2IN	WHITE/RED	Pin 5
IG2OUT	WHITE/BLUE	Pin 14

The timing for this output is calculated from CB1 (IG1IN) and applied to the IG2OUT. That is to say that the IG2IN signal can be any signal (Cam?) but it will be advanced or retarded in SYNCH with the IG1OUT signal.

The polarity and level settings in the global (F3) screen apply to the second ignition.

A timing diagram shows it.



10. MISSING TOOTH APPLICATIONS

This operation is specified with MODE=1.

	INPUT:	IG1IN	yellow	pin 8
	OUTPUT:	IG1OUT	white	pin 17
Secondary	OUTPUT:	IG2OUT	white/blue	pin
14				
Bipolar	OUTPUT:	IG1SP	pink	pin 16

The IG1IN signal serves as a map deflection input, and requires that the signal repeats every engine turn. This is normally the case with crankshaft triggers. Consult the factory if you have a missing tooth CAM trigger, which repeats every two turns.

The output has the same characteristics as the input signal, but it is a 12V square wave.

The input/output is affected by:

- Ign input polarity:
- Ign output polarity:
- Bipolar (Magn.) inp:
- One missing tooth:
- Teeth per turn:
- Teeth per firing:

At RPM position zero (bottom map row) the output signal is copied from the input to the output and timing is applied (regardless of your map entry!). This is particularly convenient for starting the engine, and for "first time" testing.

Set the bottom RPM scale to 3000 RPM (RS 3000), and try to start the engine. Change polarity and trigger level until the engine runs smoothly. You may "tee" in the IG1IN signal first, and then monitor the output IG1OUT for matching the input.

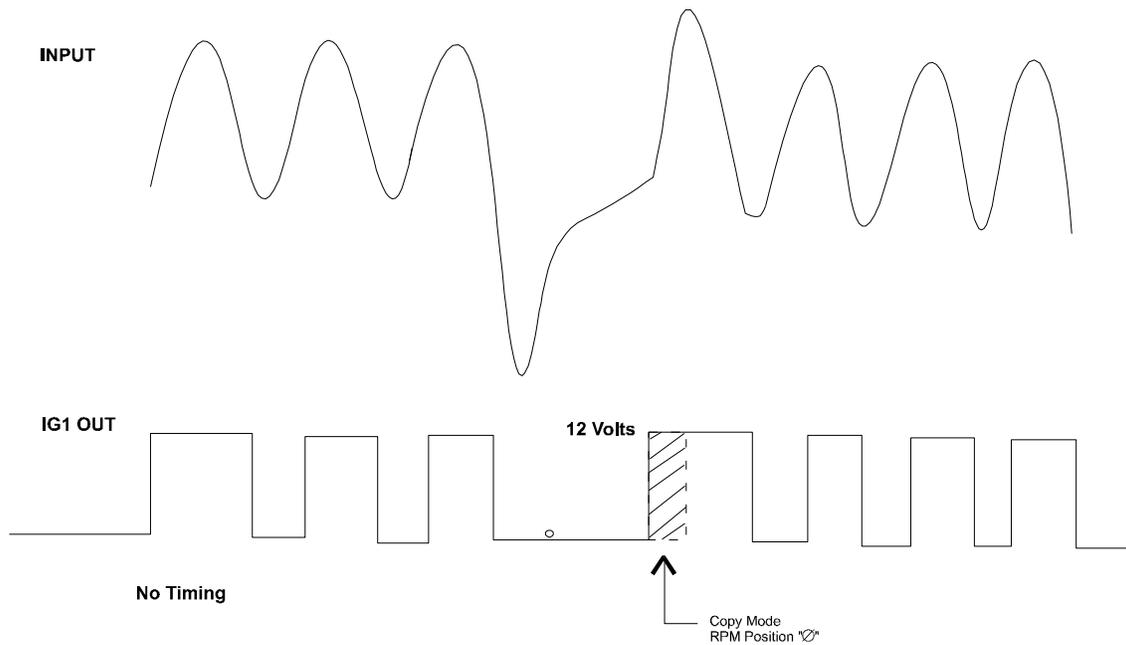
Depending on what signal your ECU requires, you may try the alternative output:

Bipolar OUTPUT: IG1SP pink pin 16

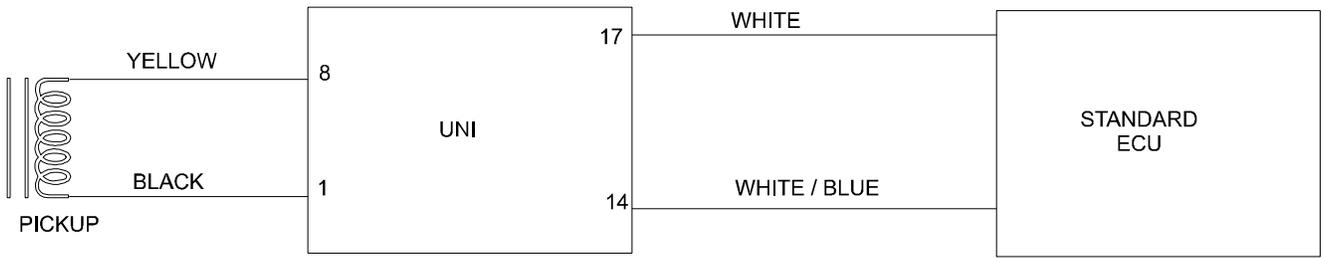
This IG1SP signal swings from -8 volts to +8 volts.

The second output is IG2OUT. It is an INVERSION of the IG1OUT signal. Some ECU's with "balanced" inputs require two "opposing" input signals to trigger.

The following picture shows a good input trigger signal, with the output shown without any timing applied. The output can be retarded and advanced by up to two teeth (minus one degree). The output contains one or two missing teeth as specified, regardless of the input signal.



Wiring for "Balanced" output:



11. ROAD SPEED GOVERNOR

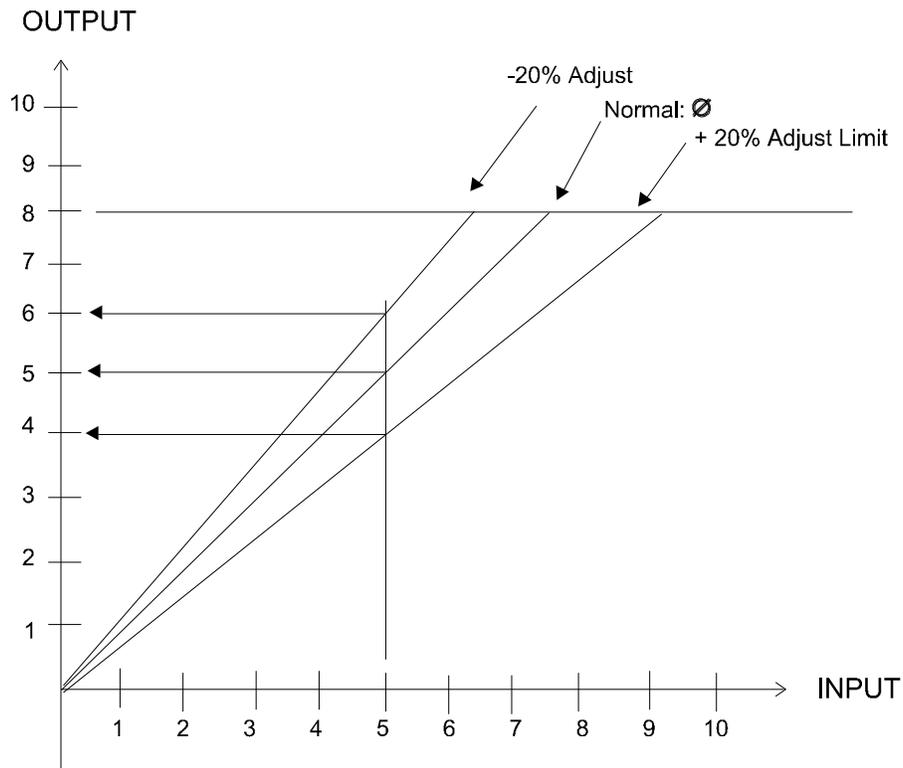
The road speed governor is selected with MODE=11. That is to say it works with the single ignition system.

Input:	IG2IN	WHITE/RED
Pin	5	
Output:	IG2OUT	WHITE/BLUE Pin 14

The following parameters are active for ROAD SPEED GOVERNOR ONLY:

HIGH FREQ OR SPEED:
UPPER SPEED LIMIT:

Note: The roadspeed governor requires no map deflection or RPM deflection inputs.



Physical frequency limit of the output signal:

High freq or speed: 0 1

Output frequency limit: 3kHz 17kHz

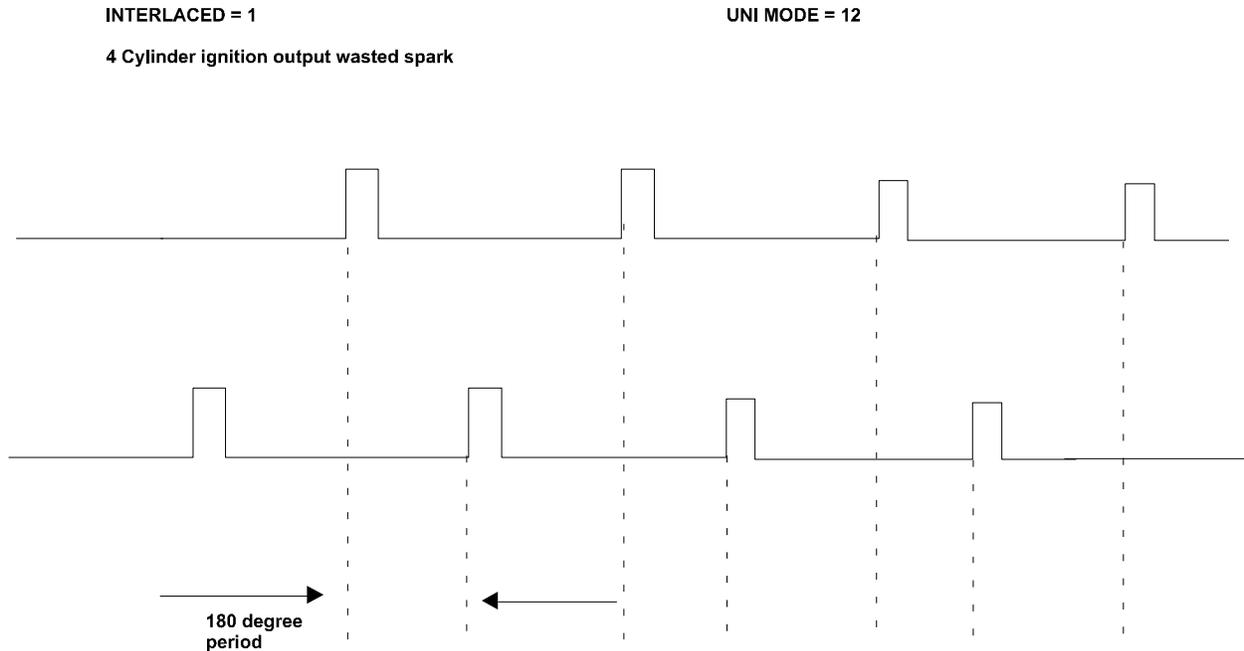
Note: The upper limit on the global screen (F3) is a “period” measurement, but the preceding graph depicts it as a “frequency” limit. By using the “SS” SET SPEED command while the vehicle is travelling just before the Actual speed limit, the period is properly calculated and set.

The above graph shows that the output “slope” can be proportionally adjusted, which would affect the gear-change points and the road speed governor. By limiting the output frequency, only the road speed governor is affected. However, both the frequency (speed) adjust AND the speed limit can be used simultaneously to achieve any desired effect.

To deviate the upper speed limit: enter Ø. A very low speed limit is a large number.

12. INTERLACED INPUTS (AND OUTPUTS)

The INTERLACED operation is specified on the global (F3) screen. It assumes that the RPM per firing is measured over TWO input trigger points. This is normally the case with a 4 cylinder wasted spark ignition signal, which looks like:



Therefore, the interlaced operations mode is the same as specifying:

TEETH PER FIRING: 0.5

Which is not possible, of course. However, the following results in the same RPM indication:

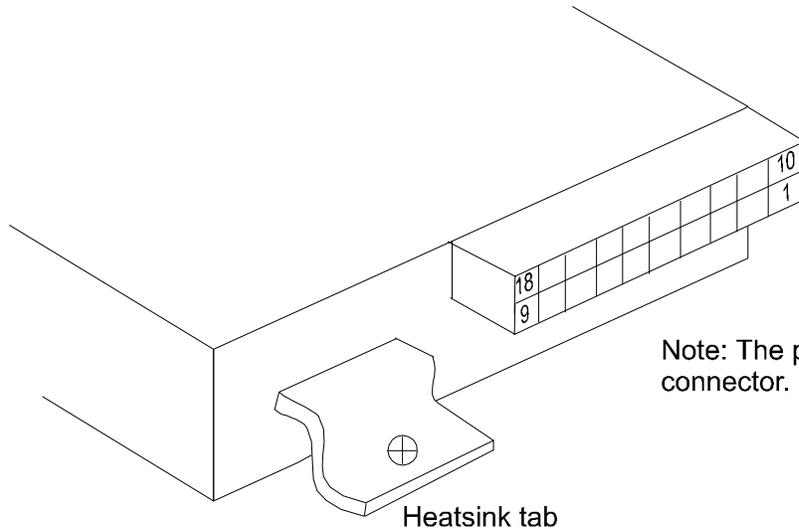
TEETH PER FIRING: 2 INTERLACED: 1
TEETH PER FIRING: 1 INTERLACED: 0

The interlaced mode applies to 4 cylinder wasted spark output modification! Other applications were not envisaged!

If the advance / retard of the two ignition signals is required, then mode = 12 must be specified.

13. ALL WIRING

The SMT has an 18 way connector:



Note: The pin numbers are on the male connector.

SMT-PIN	DESCRIPTION	COLOUR
1	Ground, GND, Chassis	Black
2	RX-Input	
3	TX-Output	
4	Map switching	Grey
5	IG2IN	White / Red
6	AIN, Analog input	Blue
7	A-DEFL, Analog deflection input	Brown
8	IG1IN, Also RPM deflection	Yellow
9	Injector, chassis, current	Green
10	+13V, Battery	Red
11	Pullup 4K7	Blue / Black
12	Pullup 4K7	Blue / Black
13	IG3OUT	
14	IG2OUT	White / Blue
15	AOUT, Analog output	Violet
16	IG1SP, Bipolar output of IG1	Pink
17	IG1OUT	White
18	Injector +, to injector, current	Grey / Black

14. SELF TESTING

The SMT-UNI can be tested by unskilled personal without any test equipment, but a special test connector. The test connector is available from your supplier, or it can be made as follows:

Pin		to	Pin	
15	AOUT		6	AIN
15	AOUT		7	A-DEFL
17	IG1OUT	2K2	5	IG2IN
14	IG2OUT	2K2	8	IG1IN
9	INJ -		1	GND
18	INJ +		4	MAPIN
18	INJ +	3E3	10	+13V
1	GND,	BLACK	to	- BATTERY
10	+13,	RED	to	+ BATTERY

Install the test program (DOS:TUNI) and
Run it TUNI
Start a test by "G" (Enter)
The unit must pass all tests!

15. PULSE WITH MODULATION

The Uni Mode = 13 activates a single ignition retard/advance AND the PWM FUEL modification. In this mode of fuel tuning an independent input frequency is copied to the output, but the DUTY CYCLE of the input is modified with a value from the fuel map.

This mode is called for tuning values and solenoid opening times, such as proportional CAM control, and boost regulation control.

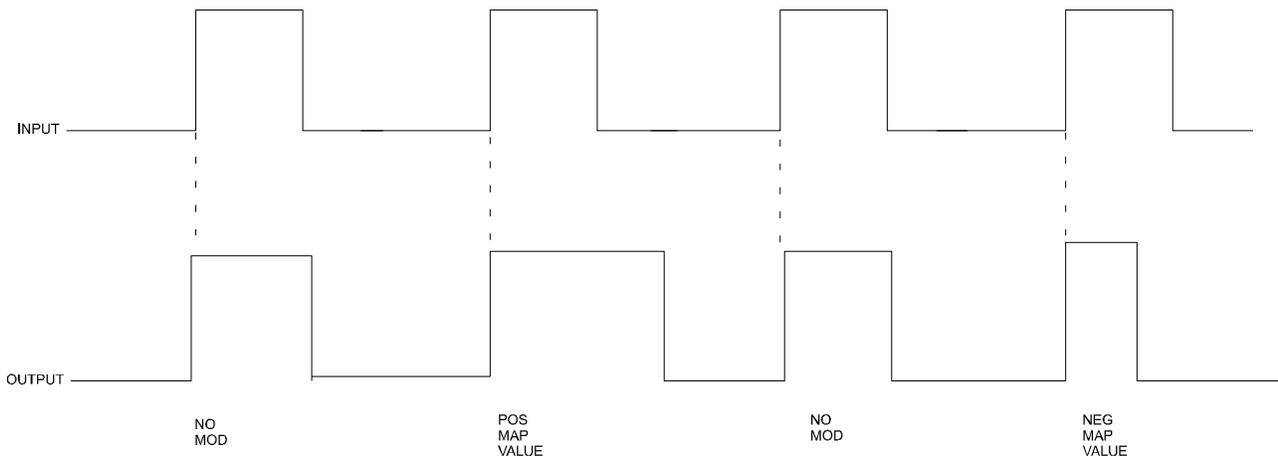
The following parameters are active:

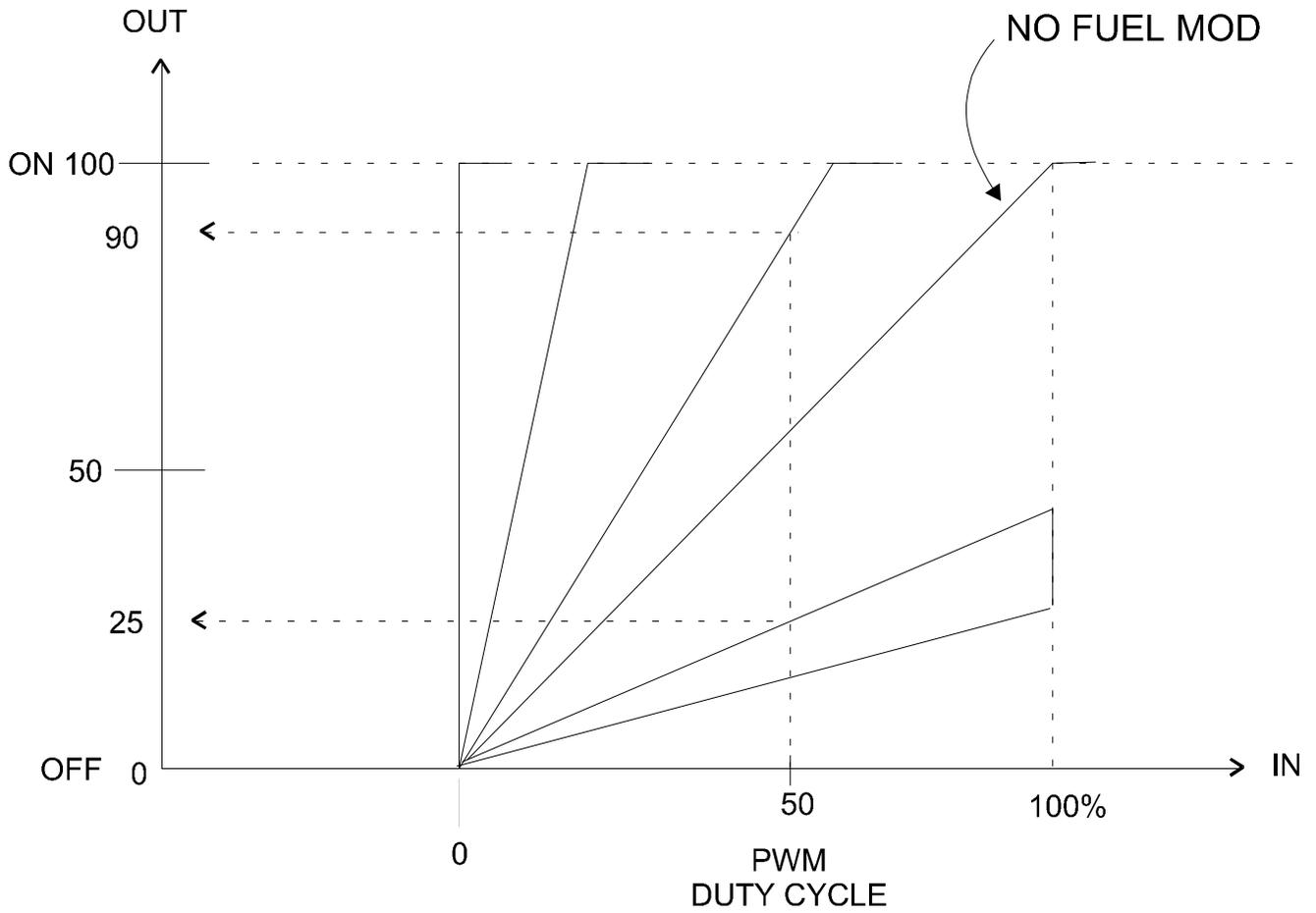
High freq or speed:
Fuel map values:

Note: The Universal SMT Version 4 does not require rpm or analog deflection, except to select a fuel map value other than in the bottom row.

PWM input : White/Red pin 5
PWM output: White /Blue pin 14

Note: A positive number lengthens the duty cycle.





Samples:

Input duty cycle = 50%

A output: Positive modulation 90%

B output: Negative modulation 25%

16. KEYWORD INDEX

Pickup relation to	A device which produces an output (change) in the crank position.
Optical pickup +12 resistor “jumps”	Normally located in a distributor. It has three wires, signal, GND. The signal output requires a “pullup” to + 12 Volts (4k7 to 10k) and then the signal wire between GND and +10 volts when the crank turns.
Magnetic pickup be One wire	Has 2 wires + a shield. The shield (screen) must be connected to the ECU GND and not to the engine. goes to the GND of the ECU, the other has positive/negative signal (see section 8) when the shaft is turned. These pickups are found on the crank or in the distributor.
Missing tooth Pickup per turn (gap)	Located on the crank, it has multiple teeth (24-60) and one or two teeth missing. The missing teeth signifies a defined crank position (TDC or other).
Interlinked signals	This means that a crank trigger signal has a defined relationship to a cam signal, and if this relationship is “modified” then the ECU assumes that the cam has slipped and the ignitions are stopped, or the ECU “misbehaves” otherwise.
Analog fuel tuning	An analog signal (e.g.: 0-5V) is modified via the fuel map.

**Frequency fuel
Tuning**

A frequency signal (e.g.: 10Hz to 18kHz) is modified via the fuel map.

PWM fuel tuning

A PWM signal is modified via the fuel map.

- PWM signal** A signal with an unimportant frequency, where the information is contained in the “duty cycle”. The SMT copies the frequency, but modifies the duty cycle. Used for proportional CAM variations and boost control.
- Injector activation** The SMT can drive up to 7 amps, which are 8 x 16ohm, or 4 x 8 ohm, or 2 x 4 ohm injectors. The injectors are activated proportional to Rpm and the map values.
- Road speed governor** This is not the RPM limit of the ECU, but a signal derived from the transmission train, which changes proportional to the road speed. This signal is used for automatic gearbox shifting and to limit the maximum speed via the ECU.
- Interlaced** The ignition on a 4 cylinder wasted spark system is “interlaced”. See section 2.
- Self Test** The SMT performs an internal self test when power is applied. However, a special self test feature can be performed via a PC and a test harness which checks every input / output for the correct performance.