



Introduces:

i - SWITCH

Intelligent Switch TUNING MANUAL V1.0

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1. GENERAL

The i-SWITCH unit is a programmable switching unit for car engines. It switches just about anything in the engine compartment. It is also great for variable CAM control, and of course the prevention of serious engine damage due to overload or over temperature. It can also be used for water spray, nitrous and other odd jobs.

2. HARDWARE FEATURES

The i-Switch was designed to complement the Piggy-back and stand-alone Perfect Power product range with a simple, programmable, but versatile switching unit for the odd jobs around an engine. Of course, it can totally act by itself, or supplement any other unit. The outputs of the unit are:

2.1 TWO SOLID STATE SWITCHING OUTPUTS

Rated at 5 Amps pulse current, these outputs are good for driving PWM solenoids, injectors or other low current devices. Switching is to ground.

2.2 TWO BUILT-IN RELAYS

Rated at 15 Amps, they can drive bulbs, or intercept high current wires. The Output is a normal open (NO) and normal closed (NC) contact arrangement, which provides complete isolation.

The inputs to the unit are:

- Crank pattern RPM input. Any trigger pattern can be converted to RPM.
- Pulse input. Intended for road speed measurement, but it can measure any consistent pulse train.
- Three analog inputs in the range from 0-5Volts. They can be connected to temperature, TPS, AFR and Manifold signals.
- Four Digital input signals. They are good for clutch, brake and other switching signals.

3. COMMUNICATION

The unit has a RS232 connection at 19.2KB.

4. FIRMWARE FEATURES

The unit is organized around the well-known SETPOINT procedure common to most Perfect Power products with one addition: VIRTUAL INPUTS and OUTPUTS. The standard set-point procedure provides:

Input sensing inversion: The input can be sensed as "higher than" or "lower than" the set limit. Example: Switch if RPM less than...

Input combining: One input can be 'combined' with any other input in an "AND" or "OR" functionality. Example: Switch if RPM is greater than ... AND if Analog input #1 is less than...

Daisy chaining: The combined input (Analog #1 in the case above) can be the combination of other channels. Example: Switch if RPM is greater than ... AND if Analog input #1 is less than ... OR analog #2 is greater than....

Each of the four outputs can be assigned to any of the processes below. The processes include Virtual inputs and outputs as follows:

The unit has 4 time delay circuits. Each delay consists of an independent timer, which is set via the set point screen. A time delay is triggered when it is assigned to a process as an output. It is also available as a virtual input, and can be combined with any other inputs. Eventual, it can produce an output. Example: Switch an output on 3.5 seconds after the RPM has exceeded 1000RPM.

5. SET POINT FUNCTIONS

The unit has 16 SETPOINT functions:

No	Function	Input
0	RPM #1	Crank signal
1	RPM #2	Crank signal
2	Analog #1 input	Analog input #1
3	Analog #2 input	Analog input #2
4	Analog #3 input	Analog input #3
5	Pulse input	Pulse input
6	Digital Input #1	Digital input #1
7	Digital Input #2	Digital input #2
8	Digital input #3	Digital input #3
9	Digital input #4	Digital input #4
10	Delay #1	Virtual delay #1
11	Delay #2	Virtual delay #2
12	Delay #3	Virtual delay #3
13	Delay #4	Virtual delay #4
14	PWM #1	PWM map output #1
15	PWM #2	PWM map output #2

The i-SWITCH unit has the following outputs:

Number	Output
0	Solid state #1
1	Solid state #2
2	Relay #1
3	Relay #2
4	Virtual: Set delay #1
5	Virtual: Set delay #2
6	Virtual: Set delay #3
7	Virtual: Set delay #4

The above procedure seems confusing at first glance. Here is how it works:

Assign the virtual output #4 (Delay #1) to any function which should trigger the delay. The delay is triggered when the function becomes TRUE.

Then pick up the delay#1 in function#10 as an input, set the required delay time (Limit), set the required polarity (High/Low) and combine it with any other functions, or assign it straight to a REAL output.

See more about this issue in: APPLICATIONS

6. PINOUT

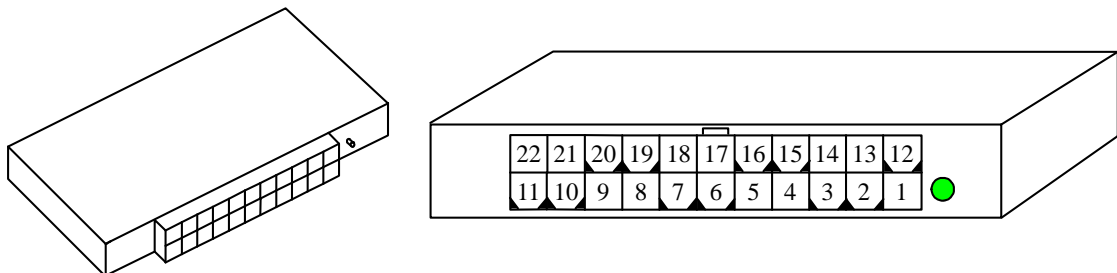


FIGURE 1. I-SWITCH PIN-OUT

PIN-OUT Table

PIN	CONNECTION
1	Common Relay #2
2	GROUND, Chassis
3	GROUND, Chassis
4	PCR _X , The unit transmits on this wire
5	Analog #3 input
6	Analog #2 input
7	Analog #1 input
8	Digital input #4
9	Digital input #3
10	Digital input #2
11	Common Relay #1
12	Relay #2 NC
13	Relay #2 NO
14	+13V, supply
15	PCT _X , The unit receives on this wire
16	Pulse input
17	Crank input
18	Solid-state switch to ground #2
19	Solid-state switch to ground #1
20	Digital input #1
21	Relay #1 NC
21	Relay #1 NO

7. OPERATION

7.1 SETTING UP

For this you need:

- The LETRIPP II PC Software
- A communication cable to the PC

The PC Communication cable can have two forms:

- A straight RS232 cable if you're PC has a RS232 port
- A USB/RS232 converter if you're PC only has a USB port

Apply power to the unit (any power supply from 6 to 18V will do) and connect the communication to the PC. For operation of the LetRipp II PC software see: The LetRipp II Software User Guide.

Once you have control over the unit's parameters, maps, and set points you need to consider the following parameters, if you think you need them for your engine job. The following explanations include the standard setup which should be used if you don't need the item. You may find that most of the items were set in the factory already.

7.2 SYSTEM DEFINITION

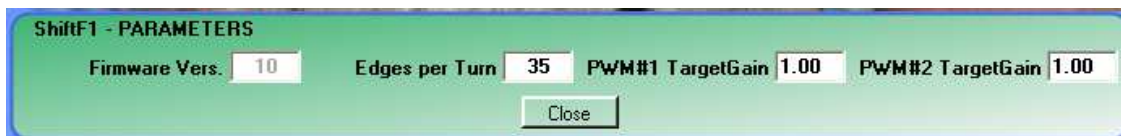


7.3 PWM ANALOG TARGET #1, 2

These items allow the analog #1 input to be used as a target for the PWM #1 output, or analog #2 input as a target for the PWM #2 output. See more under: Application: Boost control



7.4 PARAMETERS



7.5 EDGES PER TURN

These are the 'teeth' on the crank trigger wheel. Default is 35 for a 36 minus one (missing) teeth wheel.

7.6 GAIN #1, 2

This gain number in the range from 0.01 to 9.99 applies to the target difference between the analog input and the analog target map. It changes the PWM output in a boost control application. The default entry is 1.00. For details see: Applications, Boost control.

7.7 MAPS

The maps are required for the PWM output #1 and #2. The unit has two independent, but identical PWM output circuits. Only the settings for PWM #1 are explained.



7.8 PWM RPM MAP

This map has 24 entries for 1500 to 7250 RPM. The entry in the map is the PWM BASE duty cycle in the range from 1-99%, constituting almost OFF to almost ON.

7.9 PWM TARGET MAP

This map has 24 entries for 1500 to 7250 RPM. The entry in the map is an analog voltage. The map is only active if the SYSTEM DEFINITION: PWM Analog #1 Target is set.

When active, the analog #1 input is compared to the map setting at the applicable RPM, and the difference (multiplied by the gain) is used to modify the BASE PWM output. Thus a certain regulation can be achieved for boost control.

8. SETPOINT CONTROL

F1 - SETPOINTS+OUTP. <<

Name	L	F	W
RPM #1			
RPM #2	X	X	
Analogue in #1	X	X	
Analogue in #2	X	X	
Analogue in #3	X	X	
Pulse Period			
Digital Input #1			
Digital input #2	X	X	
Digital input #3	X	X	
Digital input #4	X	X	
Delay #1 Output			
Delay #2 Output			
Delay #3 Output			
Delay #4 Output			
PWM #1	X	X	
PWM #2	X	X	

L=Limit F=Function W=Wire

Name : RPM #1
Input Value : 0

Limit
Limit : 1500
High / Low Limit : High

Function
AND / OR : None
Link SetPoint : None
Soft / Hard Cut : None

Wire
Wire select : Relay #2 1-13

All engines have devices that need to be activated at certain critical times, you will learn how to activate these devices. They are activated via the i-Switch's set points.

8.1 USES

- Fuel pump activation
- Cooling fan activation
- Shift lights
- Nitrous
- Turbo Boost control

8.2 SETUP VIA SOFTWARE

Each auxiliary output can be set for a specific task. The Set point map (F1) is used for this purpose.

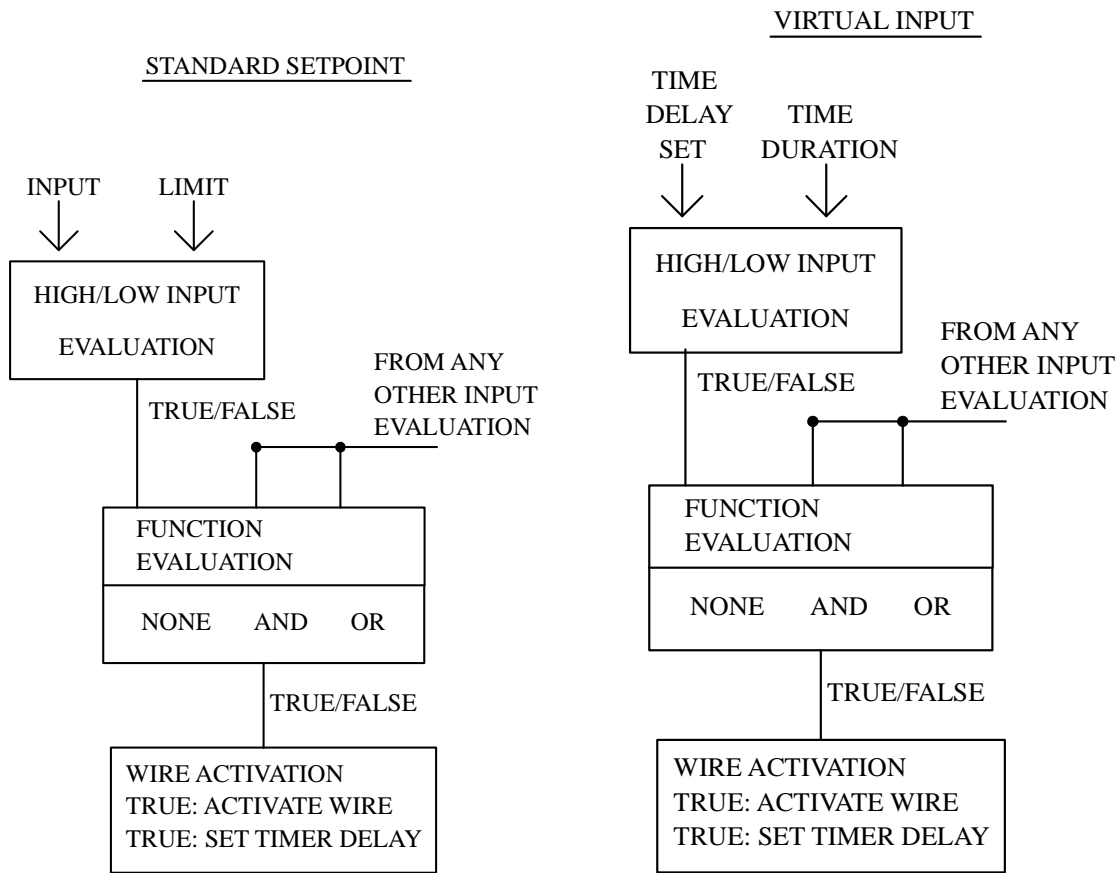
9. DISPLAY AND MONITOR

Of course, you can monitor the actions of the unit while you drive with a laptop computer. Click on the display and select the items you like to see on the laptop screen.



10. APPLICATIONS

In this section the various features of the i-SWITCH unit are explained by way of examples. This is not all you can do with it, but a small sample. The following drawing explains the basic principle and the fundamental difference to the virtual channels.



Note: The virtual channels are identical to the standard channels except:

Time delays channels: The limit specifies the time durations

PWM channels: The limit specifies the PWM repeat period

Notice that the above drawing has the same 3 building blocks as the PC screen.

10.1 INPUT EVALUATION

This section evaluates the inputs and delivers a true/false output according to the settings. The true condition is indicated as a CROSS in the first field. In the case of a virtual timer input, the limit is the timer length in seconds. The High/Low evaluation is performed.

10.2 FUNCTION EVALUATION

This section is inactive on the 'NONE' setting, but checks other input conditions in the AND/OR mode before indicating a TRUE/FALSE condition to the next section.

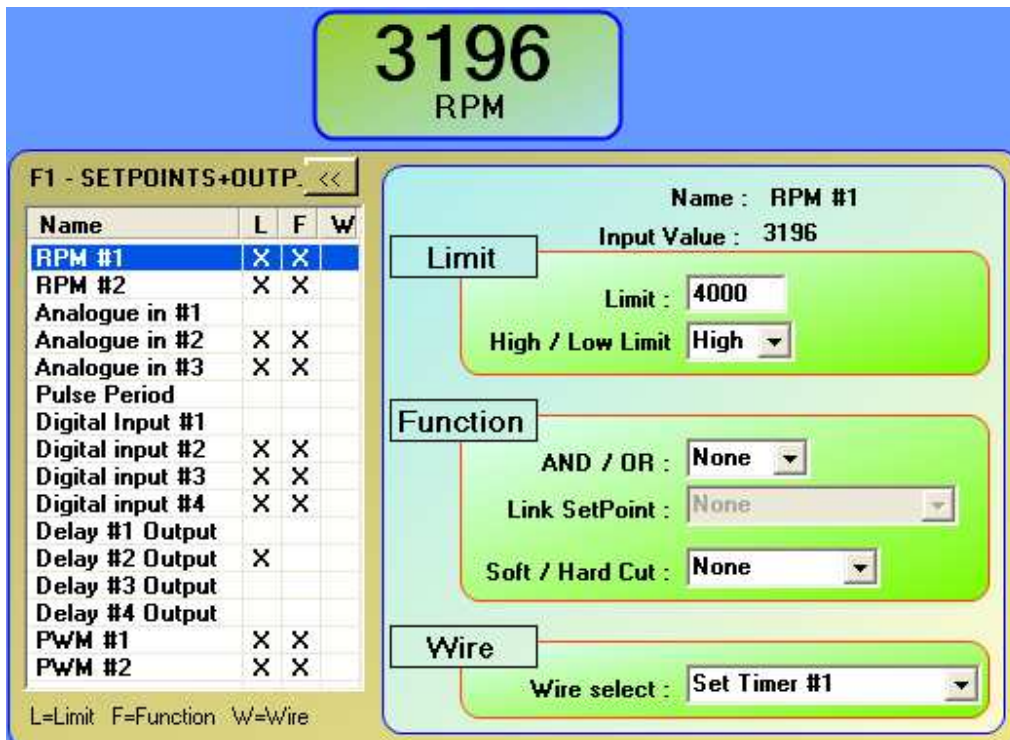
10.3 WIRE ACTIVATION

This section checks if a wire is specified and activates it. If a timer is specified, the timer is activated ONCE.

10.4 RPM LIMIT

Injection switched off 10 seconds after exceeding RPM limit

Open the set point screen with F1



- Highlight the RPM#1 line (blue)
- Set the LIMIT to the required RPM
- Set all functions to none
- Set the wire field to: Set TIMER #1

Highlight the Delay#1 output (blue)
 Enter 10.0 in the limit field
 Set High/Low limit: LOW
 Set the function to: AND
 Select the other function: RPM #1
 Set the wire to any required output, let's say relay #1

3196
RPM

F1 - SETPOINTS+OUTP. <<

Name	L	F	W
RPM #1			
RPM #2	X	X	
Analogue in #1			
Analogue in #2	X	X	
Analogue in #3	X	X	
Pulse Period			
Digital Input #1			
Digital input #2	X	X	
Digital input #3	X	X	
Digital input #4	X	X	
Delay #1 Output	X	X	
Delay #2 Output	X		
Delay #3 Output			
Delay #4 Output			
PWM #1	X	X	
PWM #2	X	X	

L=Limit F=Function W=Wire

Name : Delay #1 Output
Input Value : 0.00

Limit

Limit : 10.00
 High / Low Limit : Low

Function

AND / OR : AND
 Link SetPoint : RPM #1
 Soft / Hard Cut : None

Wire

Wire select : Relay #1 11-22

Explanations:

In the RPM#1 set point you have caused the setting of the time delay #1. In the Delay#1 you have set the "Limit" fields the Limit to 10 seconds and the "High/Low Limit" to LOW. This means it will go FALSE as soon as the RPM input is exceeded (400RPM). For the "Function" fields you have selected 'And/Or' to AND, "Link SetPoint" to RPM#1 and "Soft/hard Cut" to None.

At the point when the RPM is exceeded, the timer#1 goes on (FALSE). The AND function prevents the output to become true until the timer has expired, so basically after 10 seconds the relay will switch cutting power to the device.

10.4 ROAD SPEED LIMIT

Injection to be switched off 5 seconds after road speed limit is exceeded

The Road speed (PULSE INPUT) limit is measured in a period fashion. That means the period between input pulses in milli-seconds.

Note that with INCREASING SPEED the pulse period get SMALLER.

- Select Pulse Period (Blue)
- Set the required period in milliseconds
- Set the limit: LOW
- Clear all functions: none
- Set the WIRE to: Set TIMER #2

93.41

Pulse Repeat MS

F1 - SETPOINTS+OUTP. <<

Name	L	F	W
RPM #1			
RPM #2	X	X	
Analogue in #1			
Analogue in #2	X	X	
Analogue in #3	X	X	
Pulse Period			
Digital Input #1			
Digital input #2	X	X	
Digital input #3	X	X	
Digital input #4	X	X	
Delay #1 Output	X		
Delay #2 Output	X		
Delay #3 Output			
Delay #4 Output			
PWM #1	X	X	
PWM #2	X	X	

L=Limit F=Function W=Wire

Name : Pulse Period

Input Value : 93.41

Limit

Limit :

High / Low Limit

Function

AND / OR :

Link SetPoint :

Soft / Hard Cut :

Wire

Wire select :

- Select Delay#2 field
- Set the 5 second delay
- Set the limit as LOW
- Select function: AND, Pulse Period
- Select WIRE: any suitable output

93.42

Pulse Repeat MS

F1 - SETPOINTS+OUTP. <<

Name	L	F	W
RPM #1			
RPM #2	X	X	
Analogue in #1			
Analogue in #2	X	X	
Analogue in #3	X	X	
Pulse Period			
Digital Input #1			
Digital input #2	X	X	
Digital input #3	X	X	
Digital input #4	X	X	
Delay #1 Output	X		
Delay #2 Output	X		
Delay #3 Output			
Delay #4 Output			
PWM #1	X	X	
PWM #2	X	X	

L=Limit F=Function W=Wire

Name : Delay #2 Output
Input Value : 0.00

Limit

Limit :

High / Low Limit

Function

AND / OR :

Link SetPoint :

Soft / Hard Cut :

Wire

Wire select :

Explanations:

Once the input period fall below the set limit, the delay is triggered. The selected output will come on once the delay (5Sec) is exhausted.

10.5 BOOST CONTROL

The unit does not understand boost pressure but Volts. The conversion is best done on a table which shows voltage versus pressure from the sensor you use. All pressure sensors a linear. A standard 2.5Bar sensor looks like:

Bar	Volts
1.0	2.0
1.5	3.0
1.6	3.2
1.7	3.4
1.8	3.6

Your sensor may be different. It pays to get the correct voltage readings for the pressure range you like to control.

To start the process I suggest that the "LOOP CONTROL" is disabled and the installation is tested with the BASE PWM only.

ShiftF2 - SYSDEF

Ana#1PWM Target Ana#2PWM Target

Set the set point as follows:
Select the set point procedure (F1)

Select PWM#1

Select the PWM REPEAT period in the limit field: 50MS

Note: You can change this later!

The High/Low limit setting is irrelevant

Set all functions: NONE

Set the WIRE to any solid state output.

This is what the screen should look like:

The screenshot shows the 'F1 - SETPOINTS+OUTP.' screen. On the left is a table with columns 'Name', 'L', 'F', and 'W'. The 'PWM #1' row is highlighted. On the right, the configuration for 'PWM #1' is shown. The 'Limit' section has 'Limit' set to 50 and 'High / Low Limit' set to 'Low'. The 'Function' section has 'AND / OR' set to 'None', 'Link SetPoint' set to 'None', and 'Soft / Hard Cut' set to 'None'. The 'Wire' section has 'Wire select' set to 'Solid ST Pin 19'. A legend at the bottom left indicates 'L=Limit F=Function W=Wire'.

Name	L	F	W
RPM #1	X	X	
RPM #2	X	X	
Analogue in #1	X	X	
Analogue in #2	X	X	
Analogue in #3	X	X	
Pulse Period			
Digital Input #1			
Digital input #2	X	X	
Digital input #3	X	X	
Digital input #4	X	X	
Delay #1 Output			
Delay #2 Output			
Delay #3 Output			
Delay #4 Output			
PWM #1	X	X	
PWM #2	X	X	

Name : PWM #1
Input Value : 50.0

Limit : 50
High / Low Limit : Low

Function : AND / OR : None
Link SetPoint : None
Soft / Hard Cut : None

Wire : Wire select : Solid ST Pin 19

L=Limit F=Function W=Wire

At this point you have a PWM output repeating at 50 Milliseconds. The Duty Cycle of the output must be specified in the PWM-RPM table.

The screenshot shows the 'F1 - SETPOINTS+OUTP.' screen. On the left is a table with columns 'Name', 'L', 'F', and 'W'. The 'PWM #2' row is highlighted. On the right, the configuration for 'PWM #2' is shown. The 'Limit' section has 'Limit' set to 50 and 'High / Low Limit' set to 'High'. The 'Function' section has 'AND / OR' set to 'None', 'Link SetPoint' set to 'RPM #1', and 'Soft / Hard Cut' set to 'None'. The 'Wire' section has 'Wire select' set to 'Solid ST Pin 18'. A legend at the bottom left indicates 'L=Limit F=Function W=Wire'.

Name	L	F	W
RPM #1	X	X	
RPM #2	X	X	
Analogue in #1	X	X	
Analogue in #2	X	X	
Analogue in #3	X	X	
Pulse Period			
Digital Input #1			
Digital input #2	X	X	
Digital input #3	X	X	
Digital input #4	X	X	
Delay #1 Output			
Delay #2 Output			
Delay #3 Output			
Delay #4 Output			
PWM #1	X	X	
PWM #2	X	X	

Name : PWM #2
Input Value : 50.0

Limit : 50
High / Low Limit : High

Function : AND / OR : None
Link SetPoint : RPM #1
Soft / Hard Cut : None

Wire : Wire select : Solid ST Pin 18

L=Limit F=Function W=Wire

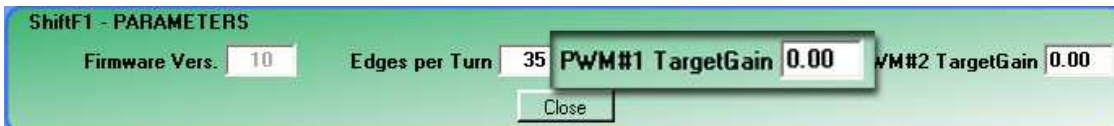
The best is to run the engine up on a dyno and adjust the PWM at each RPM spot and set the BASE PWM. This gives you a good start.

To enable the control loop:
Bring up System definition (Config, Sysdef)



Tick: Ana#1PWM Target
This setting enables the control loop. You enter the required voltage for the manifold pressure against each RPM. Change the gain to achieve a suitable stability!

Gain setting: Config, Parameters: Gain



Start of with a gain setting of 1.00 and increase it if you have to poor regulation with no overshoot. Otherwise decrease it. Any number from 0.1 to 9.99 is acceptable!

10.6 VARIABLE CAM CONTROL

The unit has two identical PWM circuits, which can be used for the inlet and exhaust CAM.

Set the set point as follows:

Select the set point procedure (F1)

Select PWM#1

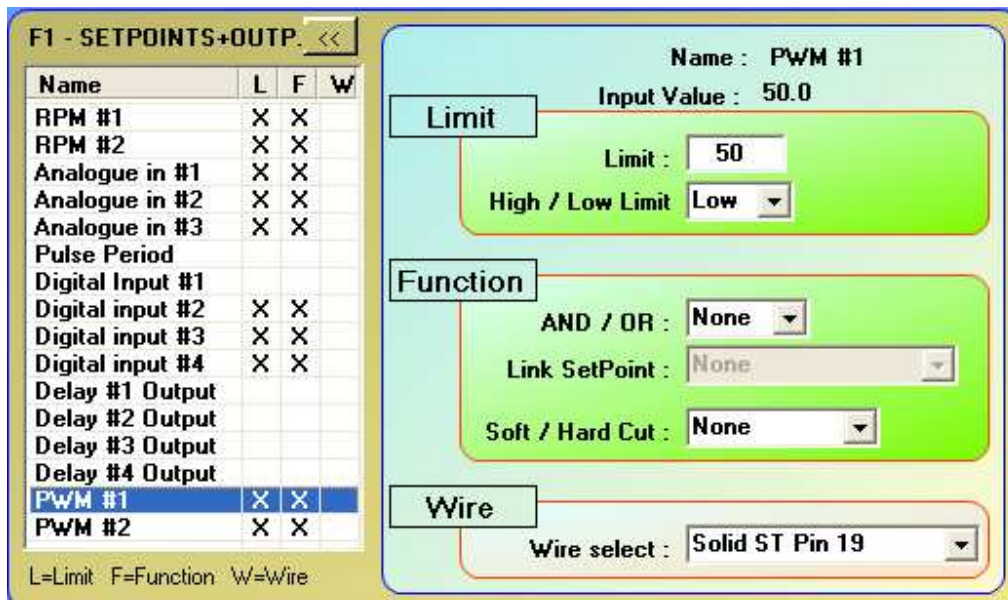
Select the PWM REPEAT period in the limit field: 50MS

Note: You can change this later!

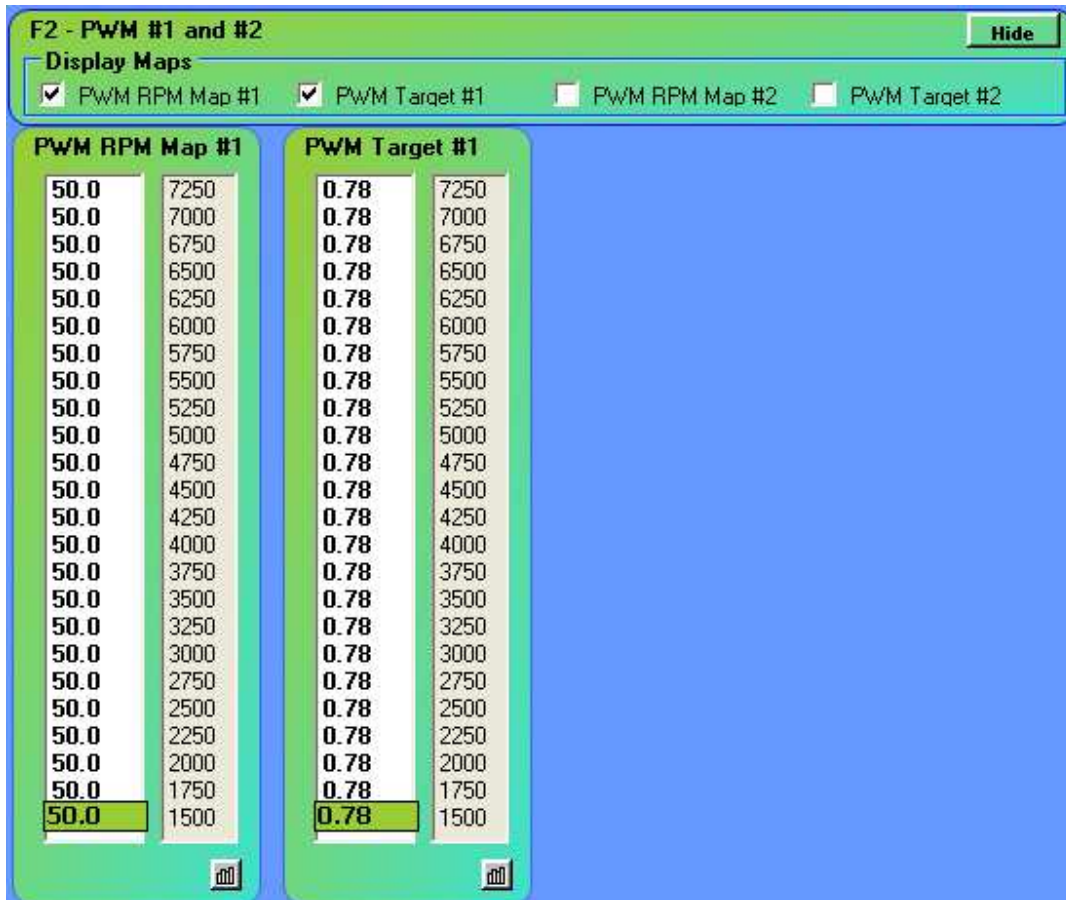
The High/Low limit setting is irrelevant

Set all functions: NONE

Set the WIRE to any solid state output.



At this point you have a PWM output repeating at 50 Milliseconds.



The Duty Cycle of the output must be specified in the PWM-RPM table.

F1 - SETPOINTS+OUTP. <<

Name	L	F	W
RPM #1	X	X	
RPM #2	X	X	
Analogue in #1	X	X	
Analogue in #2	X	X	
Analogue in #3	X	X	
Pulse Period			
Digital Input #1			
Digital input #2	X	X	
Digital input #3	X	X	
Digital input #4	X	X	
Delay #1 Output			
Delay #2 Output			
Delay #3 Output			
Delay #4 Output			
PWM #1	X	X	
PWM #2	X	X	

L=Limit F=Function W=Wire

Name : PWM #2
Input Value : 50.0

Limit

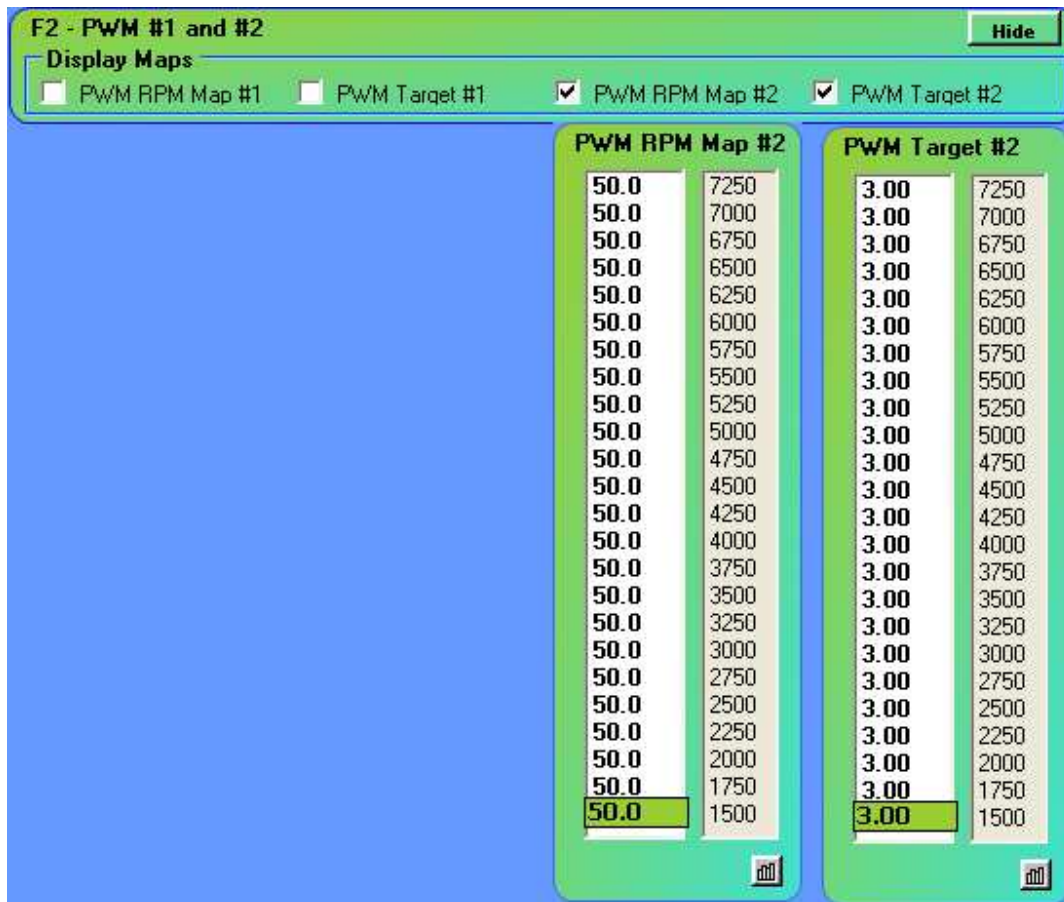
Limit :
High / Low Limit

Function

AND / OR :
Link SetPoint :
Soft / Hard Cut :

Wire

Wire select :



That's it!

10.7 FLASHING DEVICE

Let's construct a little flashing device with two timing circuits.

Delay #1 Output: Limit: 1.00 sec
 High/Low: LOW

Function: None
 Wire: Set timer #2

Delay #2 Output: Limit: 0.5 sec
 High/Low: LOW

Function: None
 Wire: Set timer #1

RPM #2: Limit: 2000 RPM
 High/Low: HIGH

Function: AND
 Link to set point: Delay #1 Output
 Wire: Relay #2 1-13

This circuit oscillates with 1/0.5 seconds timing.

Any of the two timers can be used in a Function in any other application. A good application would be a temperature warning.

10.8 IGNITION CUT IF ENGINE TEMPERATURE EXCEEDED

It requires that you attach an analog input to the temperature sensor in the car. Most temperature sensors are an NTC type, which implies that with increasing temperature the voltage declines.

Set the set point as follows:

F1 selects the screen

Click on analog input #1 (blue).

Set the limit to a suitable voltage BELOW the indicated input voltage.

Set High/Low: LOW

Function: NONE

Wire: Relay#1

Wire the ignition coil supply through pin 11 (Common) and pin 21 (NC) of relay #1.

10.9 MULTIPLE SET POINT CONDITIONS

Very often it is important to combine multiple signals to achieve the required result. For instant: You like to flash an alarm when the engine is at full load, and the temperature is exceeded, and the RPM are above 2000.

Wire the TPS to Analog #1 input

Set up analog #1: Limit, High

Set up RPM #1: Limit: 2000, High

Set up Analog #2: Limit, LOW (NTC!)

Set up Timer#1, 2 as above for flashing.

Tie everything together:

Analog #2 function: AND, Timer #1

Analog #1 Function: AND, Analog #2

RPM #1 Function: AND, Analog #1

Activate an output:

RPM #1 Wire: Select a suitable output!

The selected output will FLASH when the engine is at full load, AND the temperature is exceeded, AND the RPM are ABOVE 2000.

10.10 NITROUS CONTROL

Nitrous and fuel are normally controlled by a throttle switch and a manual enable switch. Of course, there are variations to the control operation, but they all involve SWITCHING the nitrous ON and OFF, as opposed to the PROPORTIONAL switching.

This section deals with the simple ON/OFF control.

Objective: Switch on Nitrous at more than 95% throttle and more than 2500RPM.

Connect the TPS to any analog input, and enter the 95% equivalent voltage as the limit. Set the direction HIGH. Then set the Function to AND, and the RPM channel

you have chosen. Select a output in the wire section, lets say relay #1. Open the selected RPM channel and enter 2500 as the limit, and select HIGH as the direction. That's it!

The relay will click in once the TPS is >95% and the RPM is >2500.

10.11 PROPORTIONAL NITROUS CONTROL

Proportional nitrous control means activating the nitrous and fuel solenoids in a pulsed fashion. The length of the pulse determines the quantity. This allows the 'fading in' of the nitrous power and it makes the power gain smoother. It prevents 'kissing the rails' when the torque steering is too much.

The pulse repeat rate is selectable between 5ms (200Hz) and 200ms (5Hz). It must be set so that the solenoids 'chatter' when activated.

Objective: Fade nitrous in at 80% throttle and above 2000 RPM

Set a RPM channel to 2000RPM, direction HIGH. Connect the TPS to any analog input, lets say #1. Specify in SYSTEM DEFINITION: Ana#1PWM1 Target.

Open PWM #1 set point procedure, and set the limit to a PWM Repeat time, lets say 10. This would be 10ms, or 100Hz.

Set the function evaluation to AND, and select the RPM channel which is set to 2000RPM previously.

Open the PWM screen with F2, and make the PWM#1 RPM and Target maps visible.

In the RPM map you can enter the PWM duty cycle at which the process should start.

Enter all zeros. Enter the 80% voltage value of the TPS input lets say 4 volts.

Then select a wire in the PWM#1 set point section, lets say solid state #1.

You can chose the effect of the TPS input on the PWM duty cycle by changing the PWM#1 GAIN in the parameters.

That's it!

When the RPM increases above 2000RPM it will enable the PWM section. When the TPS voltage reaches 80% it will output a tiny pulse, and at 85% the pulse will be bigger, and so on. How much it will grow depends on the gain. A good start is 1.0.

Variations: You can chose various starting PWM's at different RPMs and you can have different targets to suit your style and installation.

If another variable (Time or input) needs to be combined then "AND" the RPM channel to it!

11. RE-FLASHING

Should it ever become necessary, or if new software features become available, then the unit can be re-flashed in the field. The firmware can be sent via the internet, and with minimal effort can be downloaded to the unit without removing it from the car.

12. TECHNICAL SPECIFICATIONS

Supply voltage:	6-15 volt Short term 36Volts, 5 MS
Supply current:	<0.07Amps
Ambient temperature:	-30 to 75 degree C
Analog input range:	0-5Volts
Analog input impedance:	>20KOhm
Digital input impedance:	>10KOhm
Digital Pull up:	20KOhm, + supply
Solid state switch:	30% of time, 5Amp Temperature and current protected
Relay contacts:	20 Amp, 24Volt