Digital Fan Controller

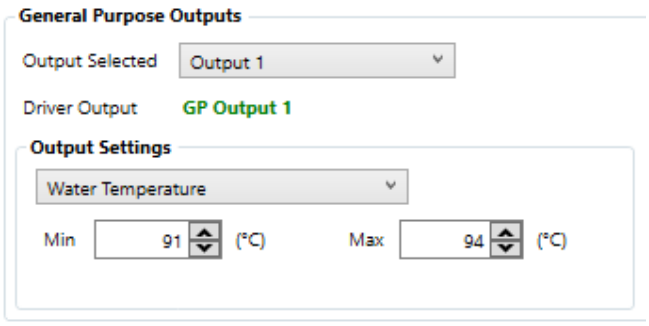
Some of the latest engine fans are speed control by the ECU. The fan itself has built in electronics and the ECU only supply a PWM pulse at a specific frequency. For the first version we used the Pluto & Pluto2 devices in Micro Hardware Class. Note that we use the ECU software as it takes time and capital to develop dedicated software. So below will follow a description on which values is used to adjust the Fan Controller.

Features

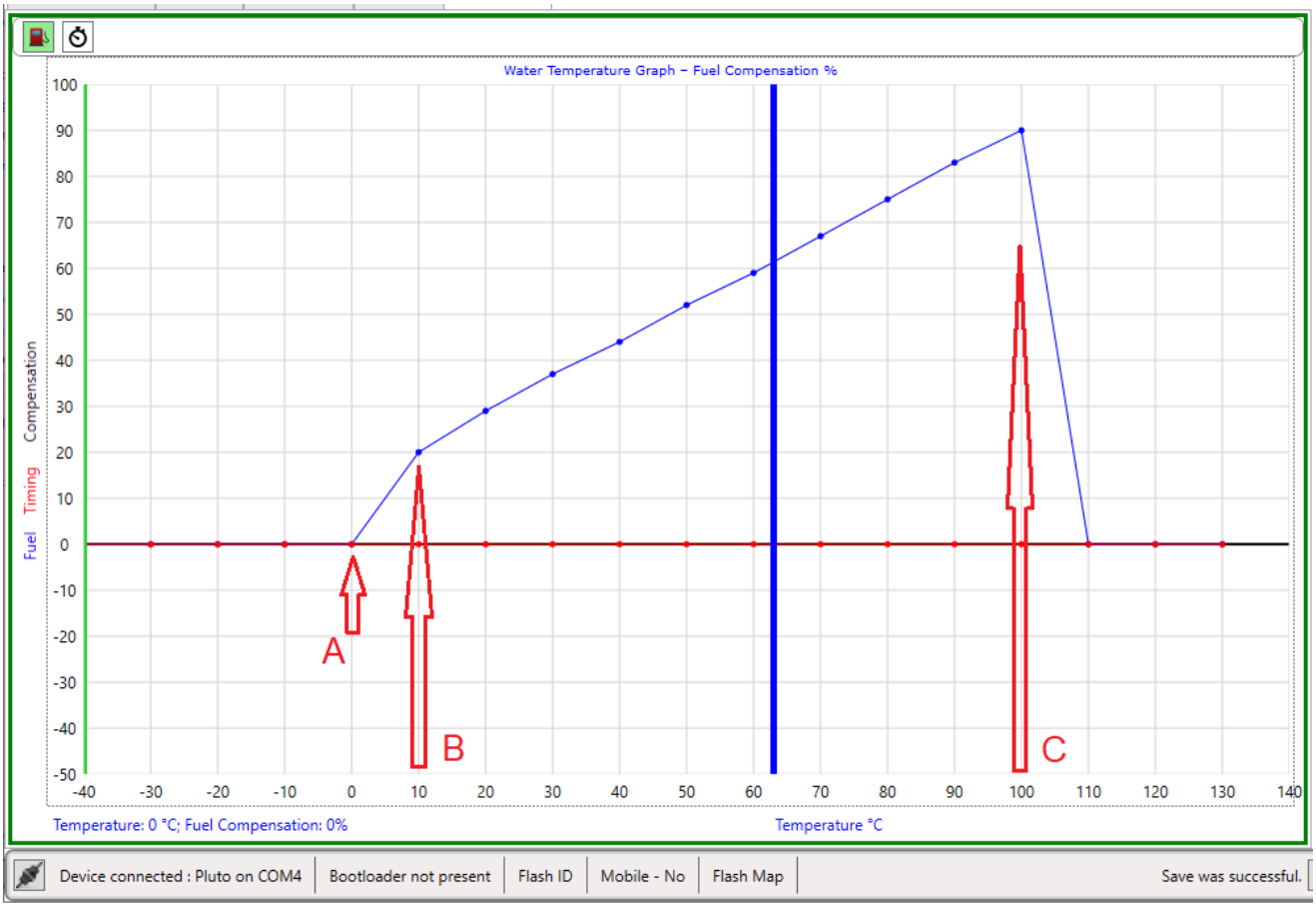
- Adjustable temperature limits with dead band.
- Adjustable Fan duty cycle curve for fast or slow reaction time.
- Override input for racing to initiate maximum speed.
- Air conditioner input for the cooling condenser.
- Different Temperature Sensor curves for standalone or Tap-In sensor applications.
- 2 x Additional GP outputs to activate extra digital fans or alarms etc.
- Led indication on the Pluto case for main fan control active or override activation.
- Different Fan types selection to ease with operation.

Operation

On the General Page set up the fan control limits.



GP Output 1 is dedicated for the PWM Fan Control. The fan will switch on when it goes above the high limit at 95°C and Off when it goes below the low limit at 90°C. The duty cycle will determine the speed as it is set on the Water temperature graph below.



Point A
This point represents your high value on the above settings. In this example see point **A** as 94°C. This means point **B** is now at 95°C. Point **C** is at 104°C. These 10 dots will let you select what the fan speed must be as the temperature goes past your high limit. Note that 0 on the vertical bar represent off and 100 represent full speed. Some fans operate between 20% and 70% duty cycle so there is no need to set it higher. 100% will most probably switch the fan off as there is no pulse.

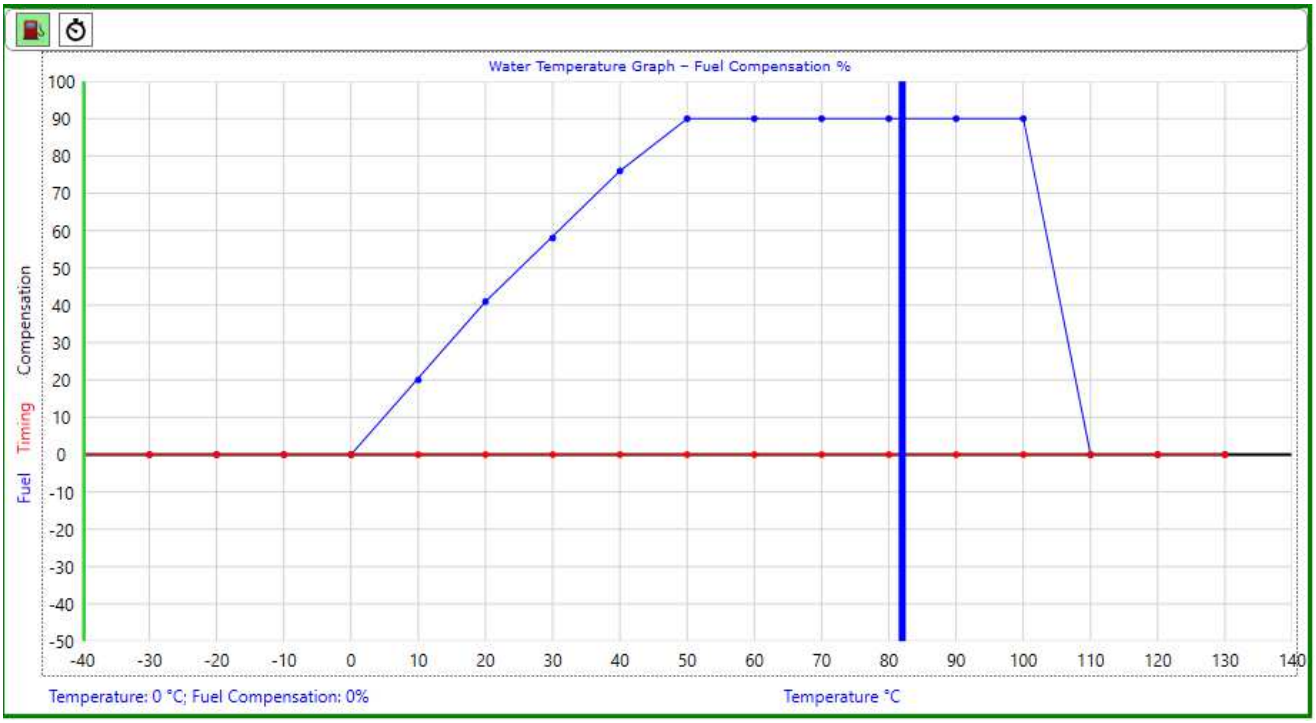
As you can see in the graph the speed will increase as the temperature increase above the high limit.
Note that the temperature bar does not determine the duty value as it cross the graph line. It Is merely the only graph in the ECU software that has a left scale of 0 to 100 that can be used for this adjustment. The blue bar will follow the actual temperature as it is measured by the sensor.

Point C
This point will be the maximum value. If the temperature goes even higher the fan will stay on this speed. Example if the temperature is 110 the duty will still be 90% as set in the graph at point **C**. Point **C** is also used when the Manual Override switch is made. This means the fan will run at 90% duty cycle regardless of the temperature of the engine. It is a useful feature where engine temperatures are high during spinning for an example. The will help keeping the engine cooler for longer periods and prolong the inevitable overheating.

Point B
This value is used during the dead band phase. It means that from 95°C down to 90°C the fan will operate at 20% PWM in this example. The reason for dead band is that when Temperature sensor is erratic around the limits it does not stop-start the fan which is irritating. If you have a stable signal this dead band can be set around 2°C. Note that when you are in the dead band area increasing from lower temperatures the fan will be off. Should you activate Manual Override or the

Air-condition input in this dead band area, and the disconnect the override, the fan will keep running at 20% value of point **B**, as if the temperature was coming from higher values.

If you want to bring the fan in more aggressively then you can adjust the graph like below. What is important is to hold the flat part of the graph unit the point **C** mark.



Dots -40 to 0 and 110 to 140 is ignored. Leave them on 0 to minimise confusion.

Manual Override

This input on the TDC input of Pluto will activate Point **C** value of the Fan speed as long as the input is hold to ground. Note that the jumpers must be set to Hall input. Use the ECU earth with this TDC wire and screen cable to minimise interference.

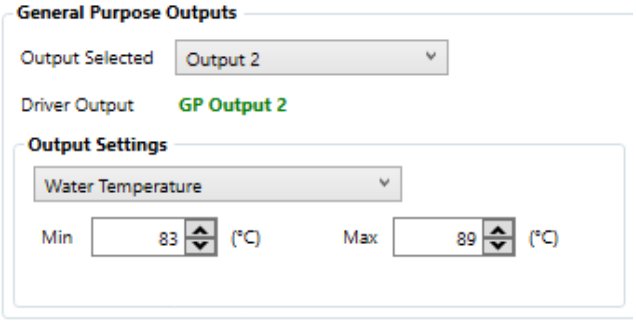
Air Conditioner Override

This input on the Crank input of Pluto will activate a value of Fan speed that is set on the **Auxiliary Pulses/RPM** block.

This value of 50% for example will activate the fan at 50% duty cycle even if the engine is cold. The reason is that the air conditioner has a pressure switch that will come on and give an earth connection when the condenser radiator is warm. The value is implemented as long as the input is hold to ground. Should the engine get hotter and demands a higher duty cycle, then this value will be ignored and the higher value will be excepted. Note that the jumpers must be set to Hall input. Use the ECU earth with this Crank wire and screen cable to minimise interference.

General Purpose Outputs 2 & 3

These outputs operate same as GP1 settings but with no PWM addition. They will simply switch on and off. It provides an earth signal for relays to be used on fans etc. It can also be used to set temperature laps on the dashboard for which a relay is not required.



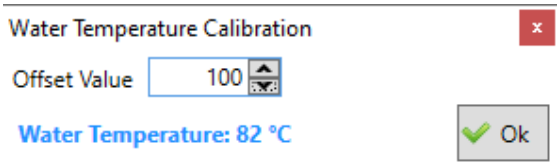
Selecting Temperature Curves

Due to the universal nature of this product we add a few temperature curves to help with calibration of different temperature sensors. Automotive sensors are logarithmic so it cannot be calibrated easily. Instead we install a lookup table into the firmware which should provide 1-degree resolution with a fair amount of accuracy. If the engine is hot you can select between the curves to see which one looks accurate. Make sure the Water Temperature Calibrate value is at 100%. The Pluto provides 2 inputs for sensors. One is for standalone temperature sensors where a pull-up resistor is required. The other input is used when you tap into existing ECU sensor. Note that the sensor volts must be a value between 0 and 5 volts. See the GP Input and Output Layout for correct connections on the Pluto.

Below is a table for existing NTC(Negative Temperature Coefficient) curves.

1 – 1K @ 25°
2 – 2K @ 25°
3 – 2.5K @ 25°
4 – 3.5K @ 25°
5 – 4K @ 25°

Next to the Water temperature select button is a calibrate button.  This will allow you to shift the whole temperature curve to increase accuracy. Start with 100% where it should be. Now warm the engine and do this calibration at the critical temperature where your fans will kick in namely around 95°C. Note that shifting the curve means the error at low temperatures will increase. But this is not critical. Even if the temperatures are not accurate you can set values according to the cars temperature gauge or a handheld thermometer. Then use the temperature that is displayed on the real time pad.



Selecting Fan Types

Fan types differ in control frequencies and operation. To ease this, we will develop them as the present themselves.

Below is a table for existing Fan Types
1 – BMW Fan 100Hz

Duty Cycle Display

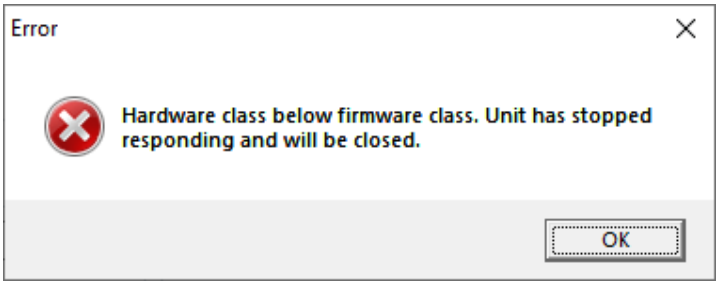
This is handy to see what PWM the ECU is generating for the Fan Control Motor. It also will help debugging your setup to see if all the features are working correctly.

ECU LED Display

This consist of 3 LED's on the Pluto Device.
Green is Power.
Yellow means there is a PWM signal to the Fan Motor
Red means one of the Override signals is activated.

Activation of the Pluto Device in this firmware

The firmware requires the Micro Hardware Class. If you have an un activated unit you need to Assign the class after Spitronics has activated your unit on the Portal. To achieve this, connect to the unit with the USB Tune cable and open the Hyperspace ECU software. Immediately you will receive this message below and the software will disconnect.



Click the ***Connect*** button  . Note that when you connect you can adjust the map and save it but the temperature sensor will stay on -40°C. This means that the unit is not operational. Do not press the ***C*** key which is the Clear Error key.

Now click ***Device*** and ***Assign Device*** buttons.

The unit will update its activation and become active. You can now tune and operate the unit.

Pluto Input & Output Layout

GP Priority List	Pluto2 Input / Outputs				GP Priority List
Priority1					Priority1
	12 Way Input				
Water Stand Alone	Water Temp	7	1	Air Temp	
	Lambda	8	2	TPS	
	.+5 Volt Out	9	3	MAP	Water Tap In
	.+12 Volt Ign	10	4	GND	
Fan Over Ride	TDC Sensor	11	5	TDC Power	
Aircon Pres Switch	Crank Sensor	12	6	Crank Power	
	10 Way ECU				
	N1 Ground	6	1	N2 Ground	
	N3 Ground	7	2	N4 Ground	GP3 Fan2
GP2 Fan1	N5 Ground	8	3	N6 Ground	GP1 Fan Cntrol
	RPM Out	9	4	Relay Out	
	GP2 Out	10	5	GP1 Out	
	6 Way USB				
Jumper Select	Programmer 2 (Tuning Pot)	4	1	Programmer 1 (Dual Map Sw)	Jumper Select
	Receive	5	2	Transmit	
	.+5 Volt Out	6	3	GND	