LetRipp Turbo Fueller

Technical Guide

Version 1.3

dds

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1 INTRODUCTION

The Turbo Fueller 10, known as the TF10, is the ideal companion to an aftermarket turbo or supercharger installation. The TF10 product allows the concerned performance user, to handle the increased fuel demands of the engine, retard its ignition, and control (if needed) the turbo boost. All this can be done in a simple or complex way, depending on the wiring and the setup.

The TF10 product requires an external manifold pressure sensor (which spans across the increased pressure), and it can connect to any device, which has a 0-5Volt output. An AMP (Absolute Manifold Pressure) sensor can be purchased from a suitable supplier. Extra injectors (of any kind) also need to be installed to supply the increase requirement in fuel.

For tuning the TF10 product requires a Laptop Computer or PC with a USB port, and the supplied LetRipp Windows Tuning Software. Please refer to the LetRipp Windows Tuning Software Guide for guidelines on how to operate the software.

2 SUMMARY OF FEATURES

2.1 SOFTWARE

- Large 16 x 24 two-dimensional analog tuning map
- 24 sites AMP side map with extrapolation, for 3 dimensional tuning
- 24 sites Engine Temperature side map for cold climates
- 24 sites Air Temperature side map for Intercooler compensation
- 4 Boost control maps for RPM, Air temperature, low and high TPS
- Two tuning maps, which can be switched while driving
- Tuning maps can be automatically switched from either Air or Engine Temperature
- Optional Air or Engine Temperature and AMP for three dimensional Analog tuning

2.2 HARDWARE

- 2 Extra heavy-duty injector drives, with PEAK+HOLD option
- Boost control setup for turbo charger waste-gate control
- Boost control direct drive output
- 2 Analog modification channel with limit and offset facility
- 1 Crank Ignition signal input and output for retarding
- 1 CAM signal input and output for retarding
- High/Low trigger level control on all ignition signals
- USB based tuning interface

3 CONNECTION AND SPECIFICATIONS

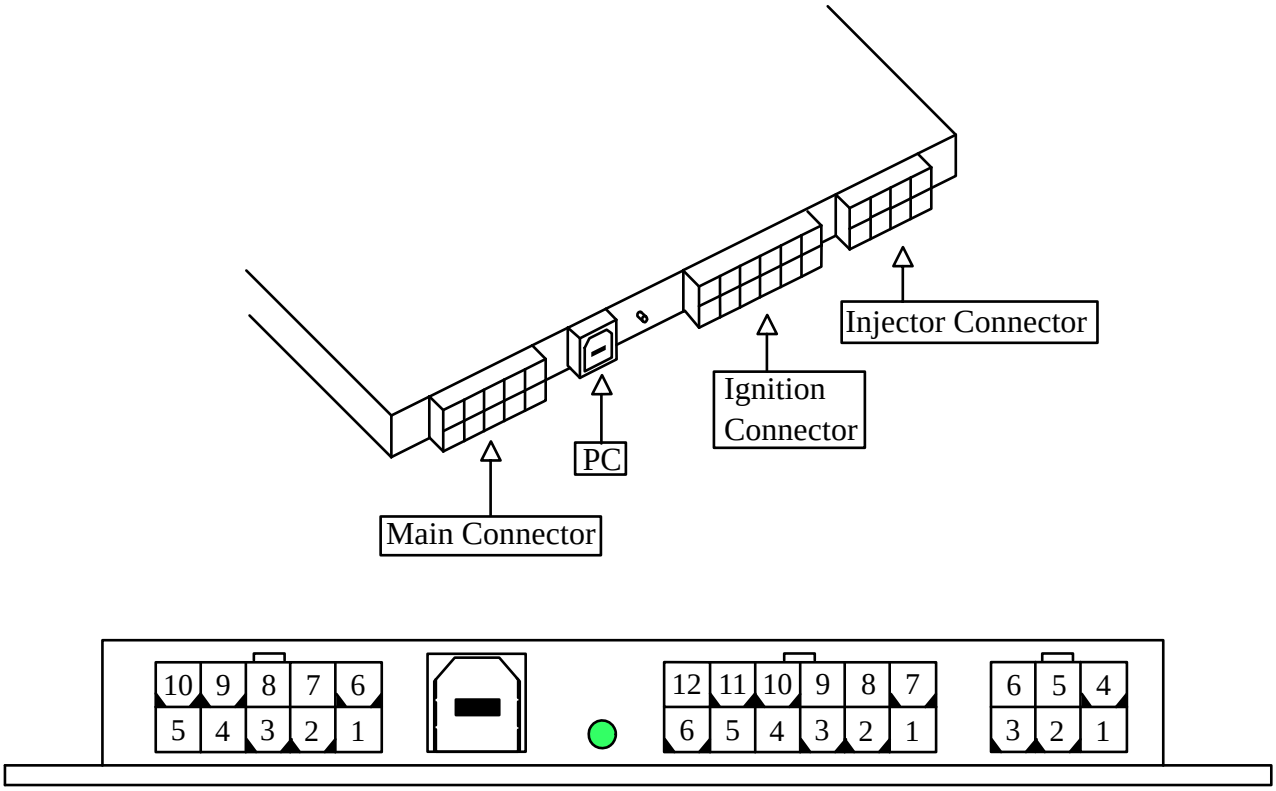


FIGURE 1.: TURBO FUELLER CONNECTOR DIAGRAM

3.1 MAIN CONNECTOR (10 WAY)

Pin	Name	Purpose / Function	Signal
1	ANA1 (in)	Analog #1 input	0-5V
2	Map Switch	Map switch input, open='MAP A'	
3	AIRT (in)	Air Temperature input	0-5V
4	TPS (in)	Throttle (TPS) input	0-5V
5	GND	Ground, Chassis	
6	+ S	Supply	8-16V
7	Launch	Clutch switch (ground when pressed)	
8	AMP (in)	AMP (MAP) Pressure input	0-5V
9	ENGT (in)	Engine Temperature input	0-5V
10	ANA2 (in)	Analog #2 input	0-5V

3.2 IGNITION CONNECTOR (12 WAY)

Pin	Name	Purpose / Function
1	GND	Ground, Chassis
2	-CB1 (in)	Balanced crank return, otherwise ground
3	-CB2 (in)	Balanced CAM#1 return, otherwise ground
4	N/C	N/C
5	ANA2 (out)	Modified analog signal out #2
6	ANA1 (out)	Modified analog signal out #1
7	+5 Volt pull-up	+5 Volt pull up output
8	+CB1 (in)	CRANK trigger input
9	+CB2 (in)	CAM trigger input
10	N/C	N/C
11	CB2 (out)	CAM output
12	CB1 (out)	CRANK output

3.3 INJECTOR CONNECTOR (6 WAY)

Pin	Name
1	PGND
2	PGND
3	PGND
4	BOOST
5	INJ#2
6	INJ#1

3.4 TECHNICAL SPECIFICATIONS

Operating Temperature	-25 to 60 deg. C
Supply Voltage	8 to 32 Volt
Momentary Supply Voltage	45V
Reverse Supply Polarity	Protected
Supply Current	Approx. 0.1A
Analog Input Impedance	30K-Ohm
Analog Output Impedance	<200 Ohm
Injector Drive, each	10A max
Peak time, if enabled	1.7ms
Hold duty cycle, if enabled	40%
Boost Drive	5A max
Ignition Signal Drive	0-12V, pull-up 2k2
Map Switch Input	Pull-up, active=shorted to ground
On-Board Indications	GREEN LED
USB Port	2.0
Size	160x100x15mm

4 TURBO FUELLER - BASIC INSTALLATION

The installation of the TF10 is slightly complicated. It is strongly recommended to do the wiring in the sequence that we suggest. It is assumed that the extra injector(s) has/have already been installed mechanically and that a suitable AMP sensor is on hand and installed.

1. The TF10 unit should be installed in a dry, cool, or well-ventilated place. Inside the cabin, or anywhere where the **temperature NEVER reaches more than 60°C**.
2. Connect the GND (Pin 5 of the 10 Way connector) to the chassis. This is the GROUND connection. The point of contact should be a clean metal surface.
3. Connect the +S (Supply wire, Pin 6 of the 10 Way connector) to +12 volts switch power. To do this, find a suitable fuse (<10A) in the fuse box. Check with a voltmeter that it has 12 volts with the ignition key on and switches OFF when the Ignition Key is removed. Connect the +S wire to the fuse side, which has no voltage when the fuse is removed with the key ON.
4. Re-insert the fuse.
5. Turn the key ON. Observe that the TF10 unit's LED comes ON.
6. The basic installation of power and ground is now complete.

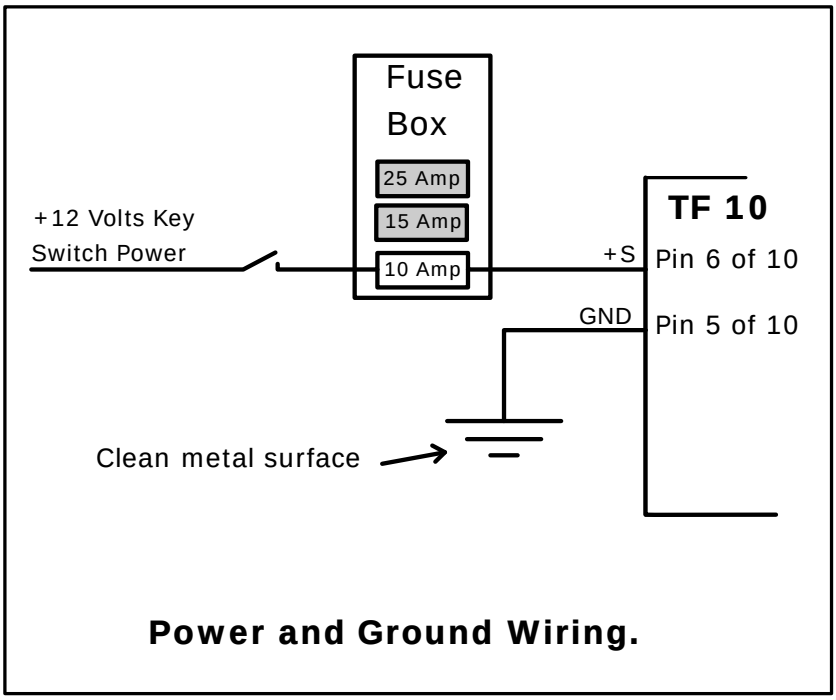
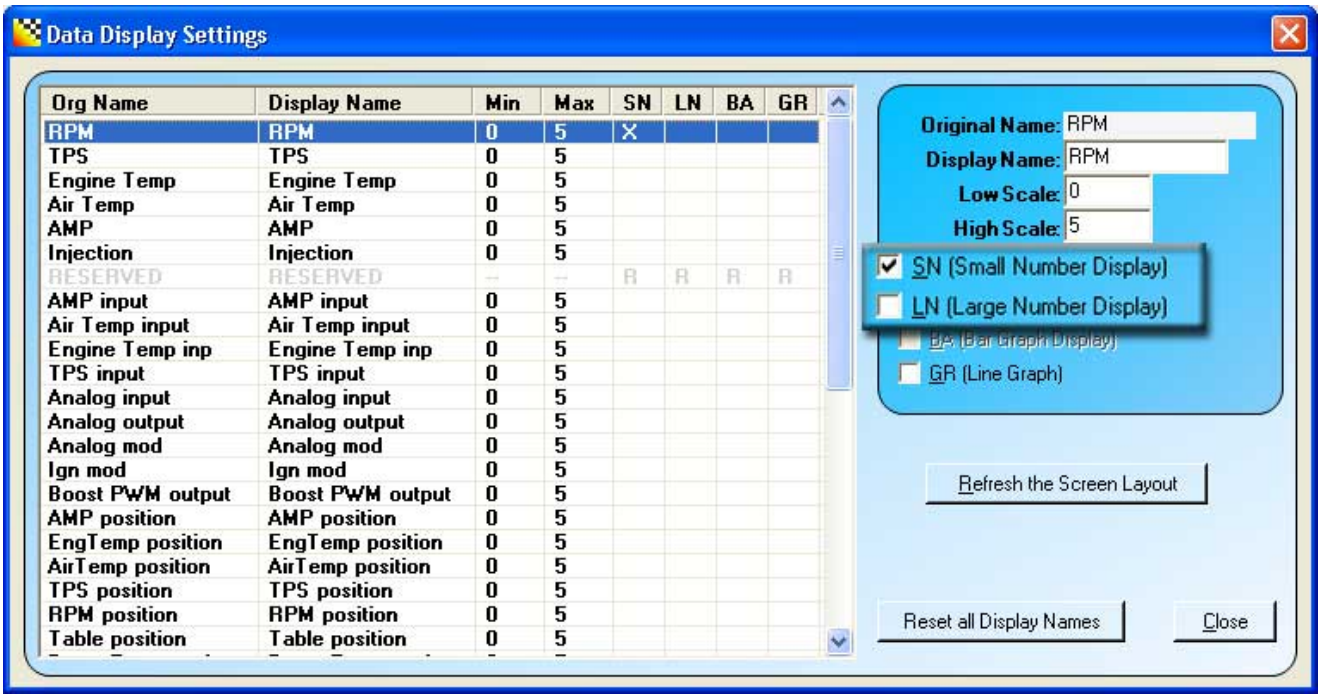


FIGURE 2.: TURBO FUELLER POWER & GROUND WIRING DIAGRAM

5 DETAILED INSTALLATION

5.1 SHOWING ALL ENGINE SIGNALS

Showing all engine signals is very helpful during wiring. Please refer to the LetRipp Windows Tuning Software Manual, which explains the PC/Laptop operation. You may have noticed that the TF10 starts operating as soon as the USB cable is connected. Although, the PC cannot drive your engine, it does provide power to the unit while the engine is OFF.



In the LetRipp Windows Tuning Software with your TF10 connected, locate the "DATA DISPLAY" button and click on any of the items, which are of interest to you. Then tick the "SN" box (for Small Number display). This action makes the selected item visible on the screen.

At this point you may wish to delete any other display items, which you are not using at this point and are only cluttering up your screen.

Here is a list of important connections for a detailed installation, and their pin locations:

Display Item	Signal	Pin
RPM	+CB1, +CB1	8 of 12, 2 of 12
AMP (MAP) (Manifold Pressure)	AMP (in)	8 of 10
TPS (Throttle Position Sensor)	TPS (in)	4 of 10
ENGINE TEMPERATURE	ENGT (in)	9 of 10
AIR TEMPERATURE	AIRT (in)	3 of 10
ANALOG 1 INPUT	ANA1 (in)	1 of 10
ANALOG 2 INPUT	ANA2 (in)	10 of 10
ANALOG 1 OUTPUT	ANA1 (out)	6 of 12
ANALOG 2 OUTPUT	ANA2 (out)	5 of 12

Most signals have two display options:

1. The Converted ENGINEERING value in Percent, BAR/LB, Degrees C/F. These readings require CALIBRATION, which associates the input reading to an output.

2. The RAW analog input voltage in the range from 0-5Volts. This is the same reading as one would see by measuring with a multi-meter.

For the time being, either one or both of these options can be displayed.

5.2 MEASURING RPM (MONITOR)

The RPM is very important. This is required for giving a "MAP DEFLECTION". The Main Maps have 16 x 24 sites, and a particular site is chosen by 16 throttle steps and 24-RPM steps. Once a site has been chosen (selected via TPS, RPM) the site value is applied to tune the engine.

The RPM should come from the CRANK sensor. Some engines have CAM sensors only. In this case, use the one which REPEATS TWICE in one CAM revolution.

The difficult part is to IDENTIFY the type of sensor you are dealing with (See: ENGINE CRANK AND CAM SIGNAL CLASSIFICATION) and you need to choose a suitable connection method (See: IGNITION WIRING for possible Crank and CAM wirings). This is a very important step, because the TF10 needs to understand the signals from the engine.

We suggest that you choose the CRANK TEE wiring for the first try. If you are experienced in electronics and engineering, then choose the final wiring which will suit your requirements.

You can wire up the RPM in any of the three following ways:

5.2.1 IGNITION WIRING FOR RPM

The Ignition can be wired up for two purposes:
A) To **MONITOR** the RPM
B) To **MODIFY** the ignition. (See: IGNITION WIRING)

It is recommended to wire up the MONITORING setup first, in order to get familiar with the LetRipp Windows Tuning Software, operate the injectors, perhaps also the boost control and analog modifications with a running engine.

NOTE: If the Ignition Modification is wired-in incorrectly, the engine will stop running.

After installing the TF10 using one of the wiring diagrams below, you will need to set up the unit via the LetRipp Windows Tuning Software to show the correct RPM. This is done via the CONFIG: PARAMETER section.

The following parameters are important:

CYLINDER: Set as required
TEETH per TURN: Set to the amount of teeth per crank turn, INCLUDING any missing teeth!

5.2.2 MONITOR RPM WITH LOGIC CRANK SIGNAL

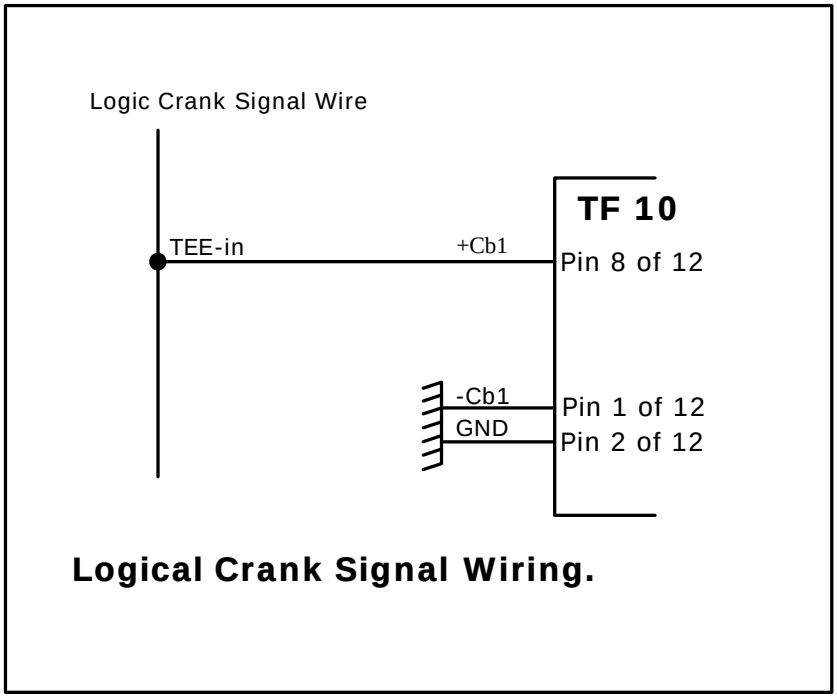


FIGURE 3.: LOGICAL CRANK SIGNAL WIRING DIAGRAM

5.2.3 MODIFY RPM FROM BALANCED CRANK SIGNAL

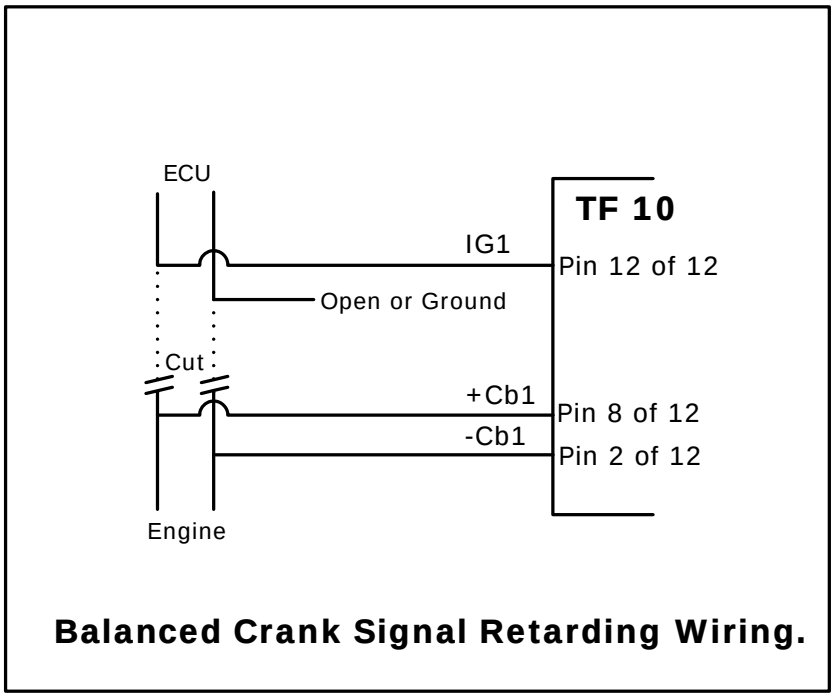
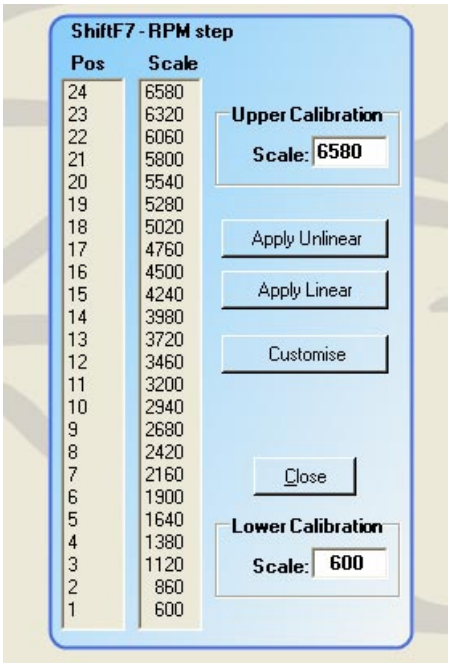


FIGURE 4.: BALANCED CRANK SIGNAL WIRING DIAGRAM

5.2.4 RPM CALIBRATION



In the LetRipp Windows Tuning Software, locate "CONFIG: RPM CALIBRATION" from the Menu, and enter the highest and lowest RPM points you will require. Then press any of the calibration options.

5.3 MEASURING THROTTLE (TPS)

The Throttle (TPS), together with the RPM, provides the main map deflection. The TPS can be swapped with the Manifold Pressure if this suits you. However, we suggest using the TPS in the conventional way, as explained below.

To do this, trace the TPS signal to a point where it is convenient for connection, and check it with a multi-meter. You need to look for a low signal (lets say 1Volt), which gets progressively higher (lets say 4Volts) as you open the throttle (push down the gas pedal).

TEE the TPSIN (Pin 4 of the 10 Way Connector) to the TPS wire (once you have correctly located it).

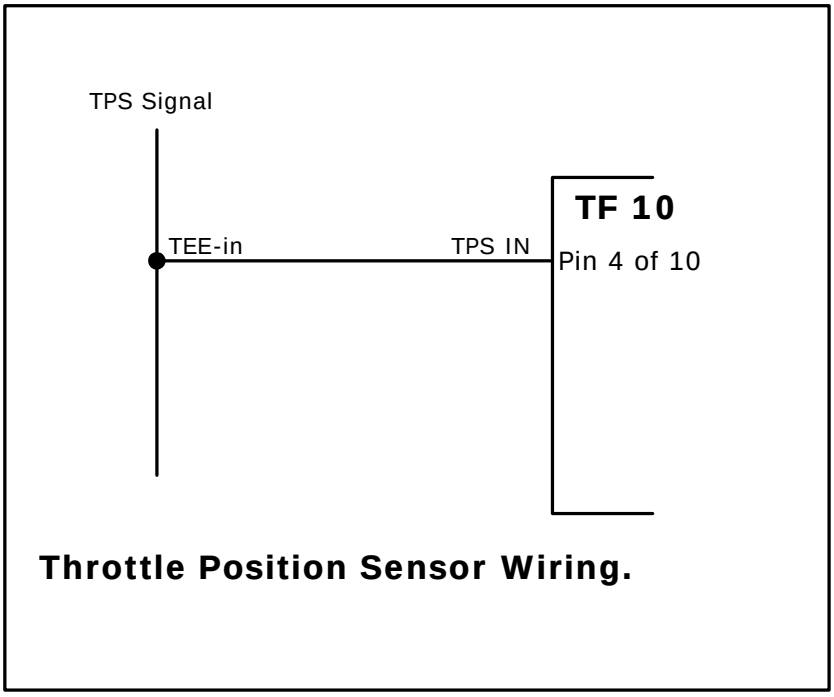
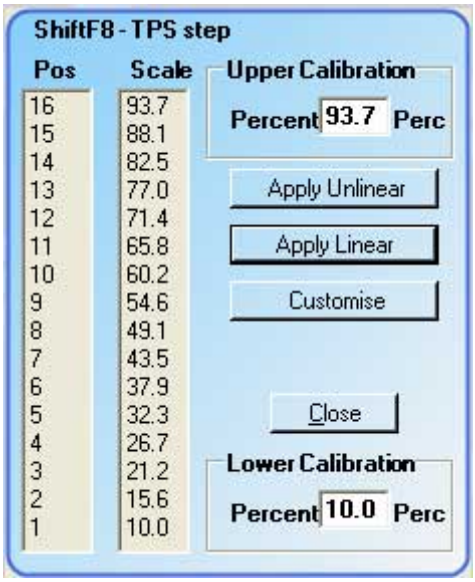
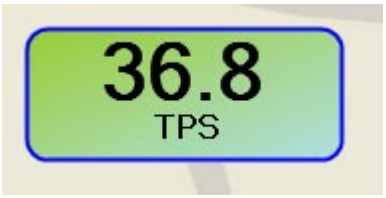


FIGURE 5.: THROTTLE POSITION SENSOR WIRING DIAGRAM

5.3.1 TPS CALIBRATION



In the LetRipp Windows Tuning Software, locate "CONFIG: TPS CALIBRATION" from the Menu and enter the closed and open throttle values obtained from the engine. The display window is activated by clicking "Data Display" and highlighting the TPS % then ticking the "SN" block). This display helps you to see what the input is doing. Push the accelerator pedal to the floor and enter the value displayed into the upper calibration. Leave the accelerator pedal and enter the value into the lower calibration. Click apply and the TPS should be calibrated.



5.4 MEASURING MANIFOLD PRESSURE (AMP)

In turbo installations the manifold pressure is extremely important. In supercharger installations it is a nice to have, but not as important.

The boost pressure is measured AFTER the butterfly; hence we call it manifold pressure. We have abbreviated this to AMP (Absolute Manifold Pressure), and some manufacturers use MAP (Manifold Absolute Pressure). It is important to use an AMP sensor, which spans the expected

boost pressure. The sensor requires 5Volts or 12Volts, excitation and ground. Under normal atmospheric pressure, the output voltage should be 2 to 3 Volts.

Wire it up to the MAPIN (Pin 8 of the 10 Way Connector), using the following diagram to guide you:

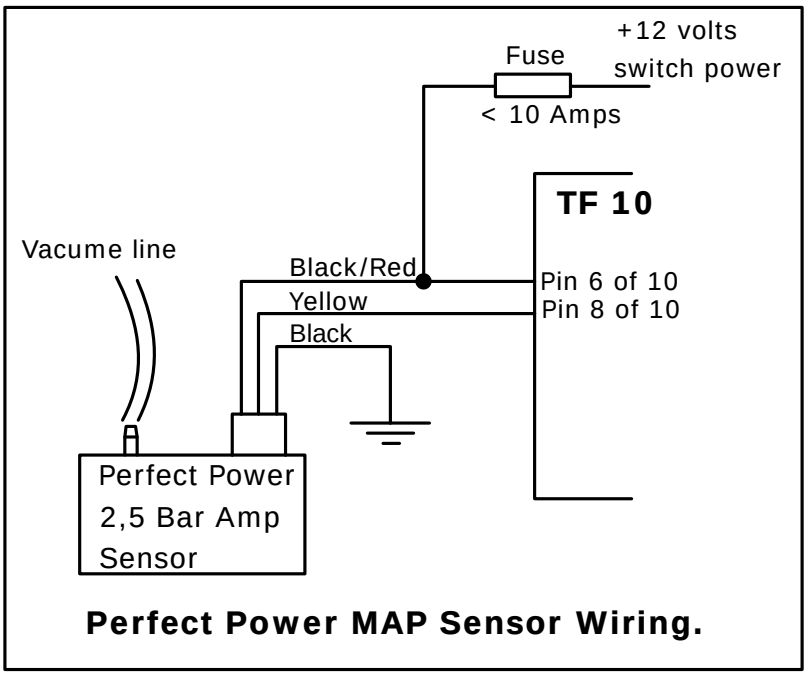


FIGURE 6.: AMP (MAP) SENSOR WIRING DIAGRAM

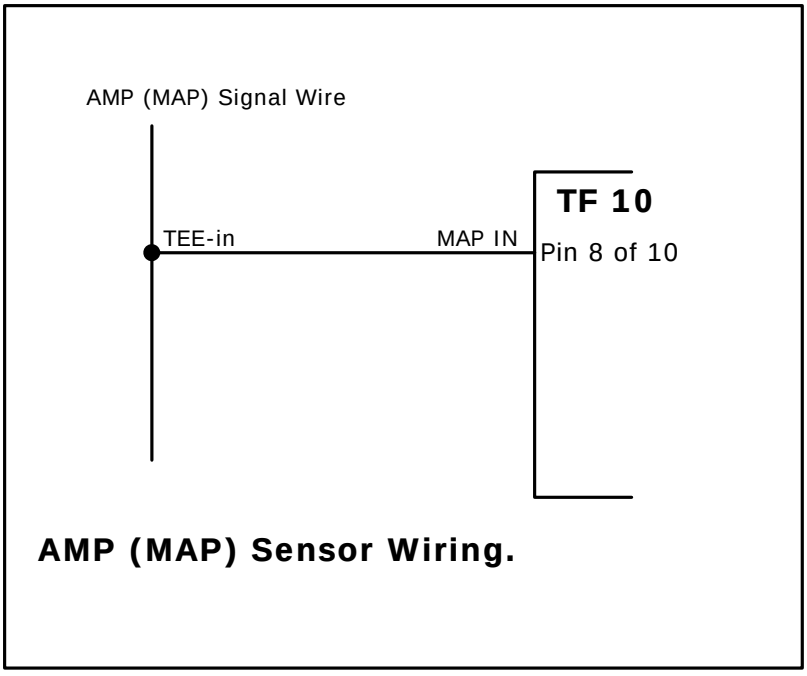
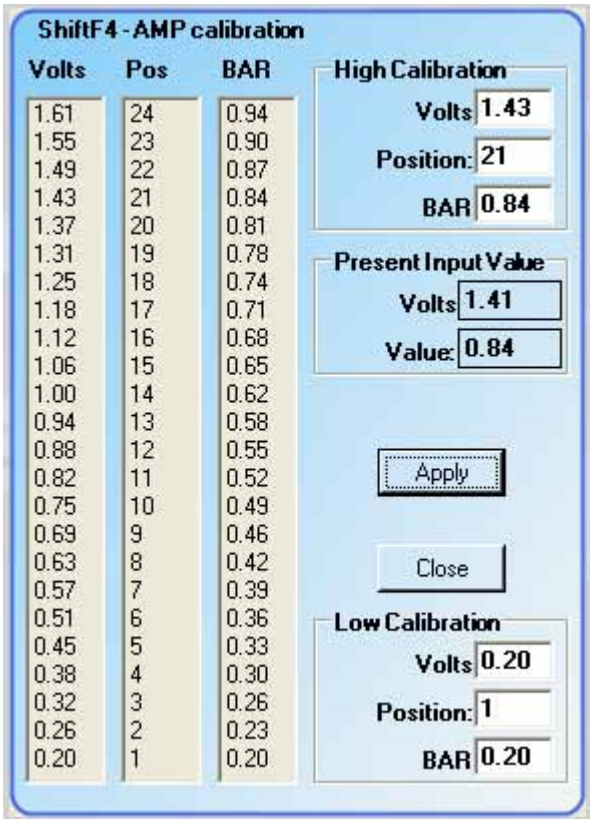


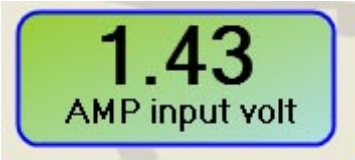
FIGURE 7.: WIRING AN EXISTING AMP SENSOR

5.4.1 AMP CALIBRATION



The AMP calibration is located in the LetRipp Windows Tuning Software under "CONFIG" from the Menu.

Enter the required span voltages and calibrate it. This may prove a little tricky because you may not have the AMP sensor data (volts and pressure at two points). For a start, you can always use the ATMOSPHERIC pressure as ONE point of the two-points of calibration, and measure or guess the other.



A more reliable method is to find the MAX WORKING pressure point (2 to 2.5 bars) and assume the following:

0.2BAR (3PSI) 0.2Volts
Working pressure 4.8Volts

Enter the above data, and if the displayed pressure indicates your ATMOSPHERIC pressure then you are done. If not, modify the max point until a correct reading is obtained.

5.5 MEASURING ENGINE AND AIR TEMPERATURE

Your engine will have an engine temperature sensor, but may not have an air temperature sensor.

The Engine Temperature sensor is not that important, unless you are planning to boost the engine when it is very cold. It requires more fuel because the air is denser and the fuel does not atomize finely enough in the cold.

The Air Temperature is very important in any intercooler installation, because the intercooler may stop functioning in traffic (stop-start slow driving) with very little airflow and subsequent rise in inlet temperature.

Locate and trace the wires you would like to connect to. The voltage on the temperature sensor wire is high when cold and comes down when warm. TEE IN to the suitable wire, once you have located it.

The Engine Temperature input ENGTIN is on Pin 9 of the 10 Way Connector, and the Air temperature input AIRTIN is on Pin 3 of the 10 Way Connector.

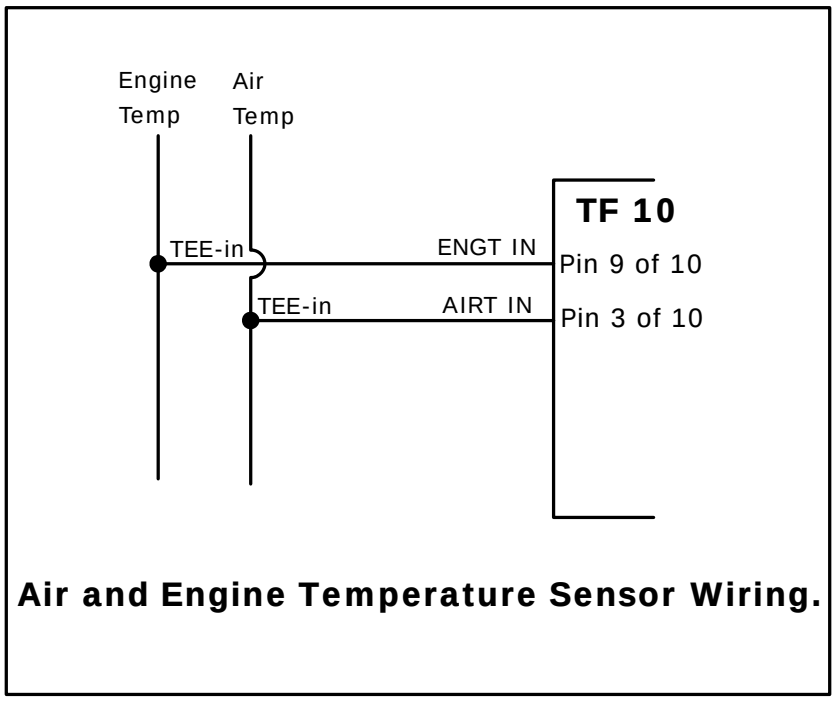


FIGURE 8. : AIR & ENGINE TEMPERATURE SENSOR WIRING DIAGRAM

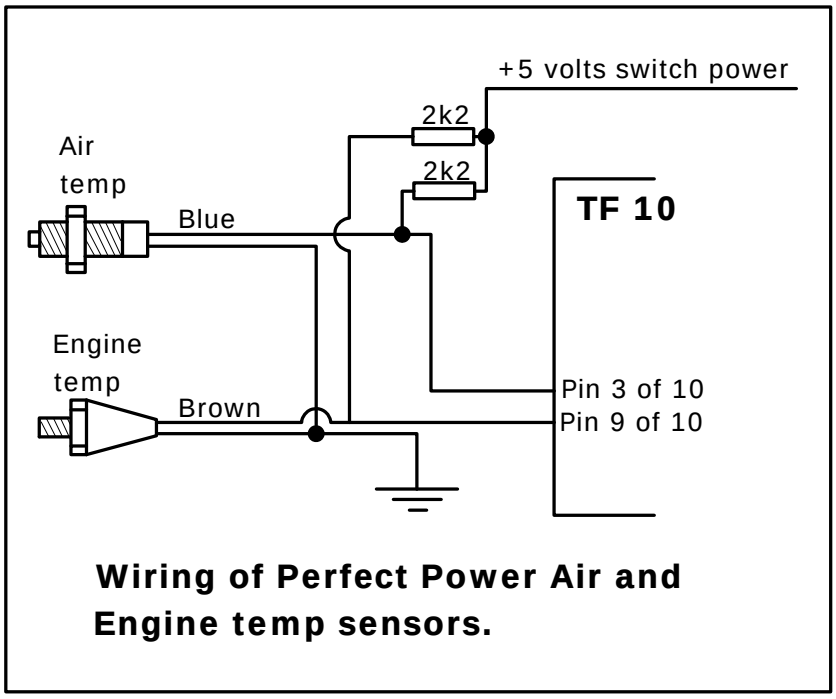


FIGURE 9. : WIRING OF PERFECT POWER AIR & ENGINE TEMPERATURE SENSORS

5.5.1 ENGINE AND AIRT TEMPERATURE CALIBRATION

The calibration is performed using the LetRipp Windows Tuning Software under the Menu item "CONFIG".

Enter the room temperature in the morning as ONE point, and a warm engine temperature as the other point. This method (and the TF10 circuit) is not very accurate because all temperature

sensors are highly UNLINEAR. Care should be taken to calibrate the normal operating point as accurately as possible.

The temperatures in-between and outside calibrating points will show an error, but this can be tuned out through the normal mapping procedure. Another way of calibrating the sensors is by placing them in boiling water.

5.6 ENGINE CRANK AND CAM SIGNAL CLASSIFICATION

It is important to know which type of CRANK/CAM signal (also known as pickup) your engine provides, because it affects the wiring and setup.

Vehicle manufacturers use two types of pickups – Magnetic and Logic:

5.6.1 MAGNETIC

This is a coil wound around a magnet, has two wires and possibly a screen third wire, and produces an AC voltage when brought near magnetic material. It requires no power to operate, but is affected by stray magnetic fields.

5.6.1.1 HOW TO MEASURE A MAGNETIC OUTPUT SIGNAL

When the voltage across the two wires is measured with a multi-meter on DC, you will get no reading when the engine runs. However, if you measure with a multi-meter on AC, you will get a reading. If you still don't get a reading on AC, you are measuring the incorrect wire.

5.6.2 LOGIC

This is a device (e.g. Hall, Optical, Other), which produces a LOGIC voltage swing (either 0 volt or a high voltage) when excited. The device requires power to operate and has 3 wires (or pins). The three pins are:

- Ground
- Signal
- Supply (either 5V or 12V)

You can identify the type by looking at it, from a manufacturer's wiring diagram, or it can be measured.

5.6.2.1 HOW TO MEASURE A LOGICAL OUTPUT SIGNAL

When the voltage between chassis and SIGNAL is measured with a multi-meter on DC you get a reading of 0.5 to 4.5 Volts or more while the engine is idling. Measuring on AC will also give you a similar reading. If you get no reading when measuring on AC, you are measuring the incorrect wire.

NOTE: The CRANK and CAM sensors can be of different PICKUP types!

5.7 IGNITION WIRING

This section refers to the wiring of a CRANK signal for the purpose of MODIFYING (Retarding) the signal. This should only be attempted when the monitor circuit works and when retarding is absolutely necessary, in order to prevent knocking.

The term retarding is used, but it actually means retard mapping at specific engine operating points. It is possible for the crank signal to pass through the TF10 without any modification, but with a very small time delay. However, the TF10 output is a SQUARE WAVE, and it is UN-BALANCED. This suits MOST ECU's, but not all of them!

NB: At this point, the installation will require an oscilloscope to verify the wiring and polarity.

5.7.1 UN-BALANCED CRANK SIGNAL RETARDING

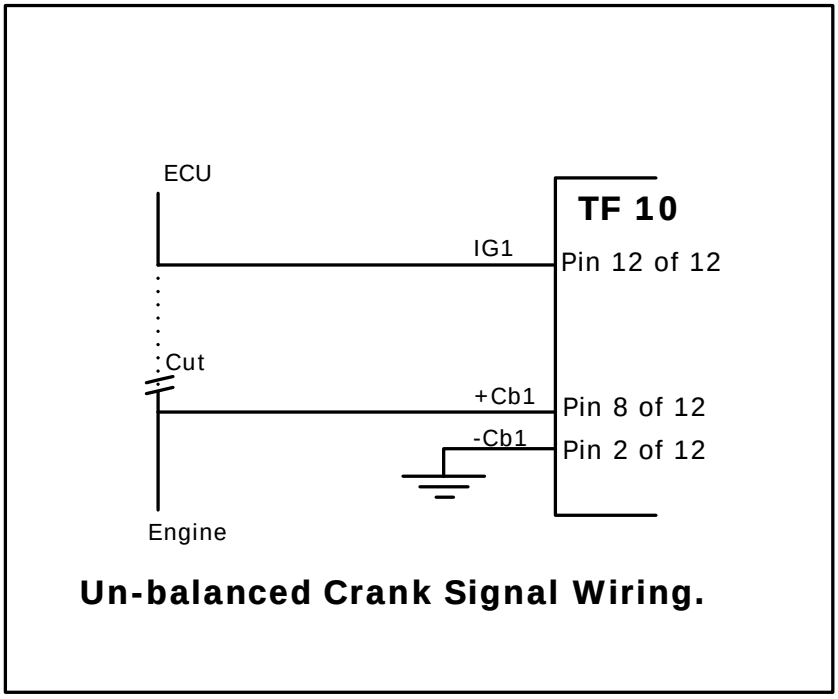


FIGURE 10.: UN-BALANCED CRANK SIGNAL RETARDING WIRING DIAGRAM

5.7.2 BALANCED CRANK SIGNAL RETARDING

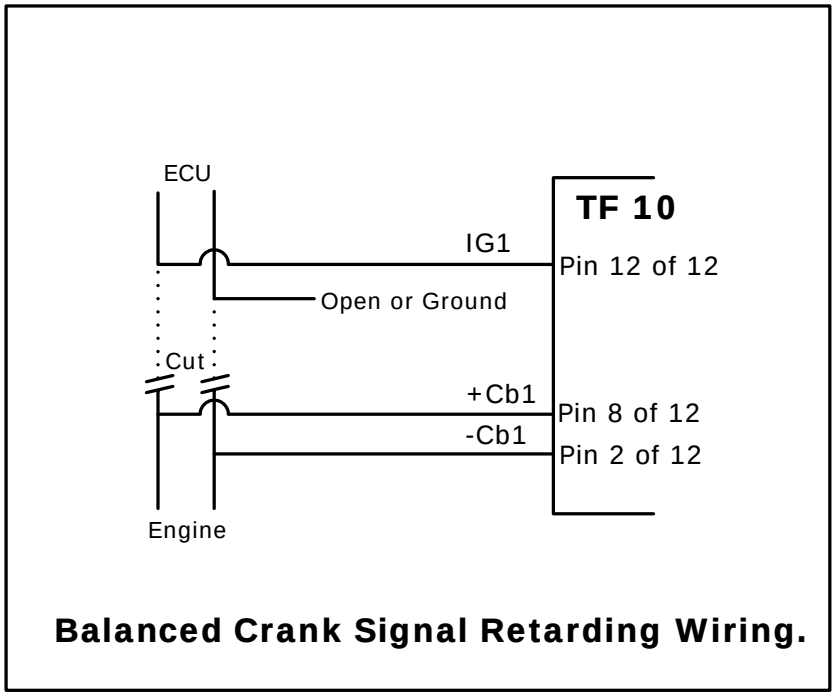


FIGURE 11.: BALANCED CRANK SIGNAL RETARDING WIRING DIAGRAM

5.7.3 CAM SIGNAL RETARDING

The purpose of retarding the CAM signals together with the CRANK signal is to prevent the ECU from detecting the CAM slip (advance).

The circuits are identical for CAM and CRANK.

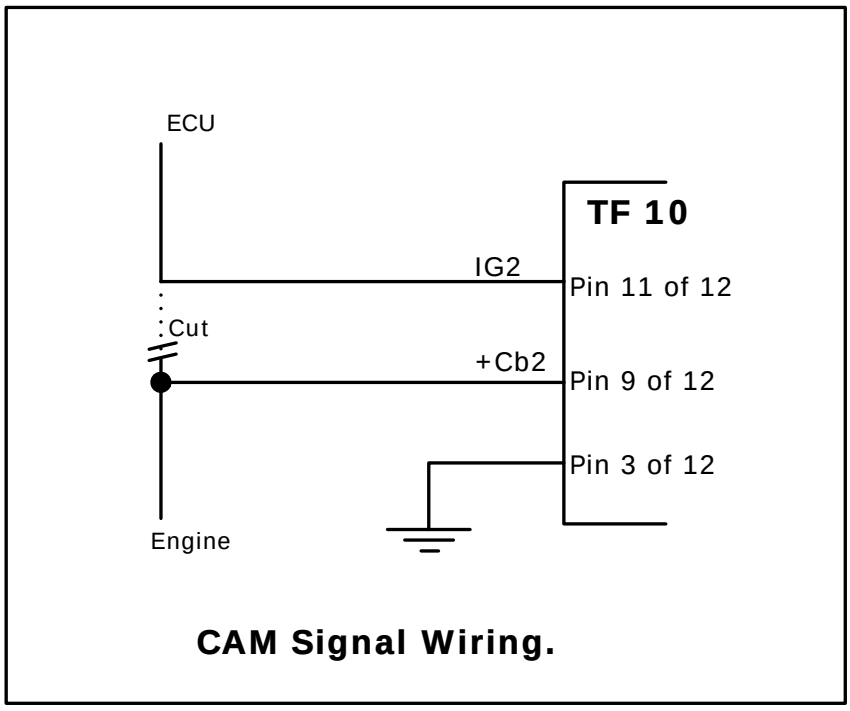


FIGURE 12.: CAM SIGNAL RETARDING WIRING DIAGRAM

5.8 MAP SWITCHING

The TF10 has TWO complete tuning maps named Map A and Map B. The maps can be switched from three sources:

1) HARDWARE:
MapSW input, Pin 2 of 10. An open pin results in Map A, a shorted pin (connected to ground) results in Map B.

2) AUTOMATICALLY:
The 'B" Map can be invoked when a settable Air or Engine temperature is exceeded. See: PARAMETERS in the LetRipp Windows Tuning Software.

3) SOFTWARE:
The LetRipp Windows Tuning Software can force (and lock) the unit to either Map. However the unit will default back to the Map A or which ever Map has been selected by the hardware switch.

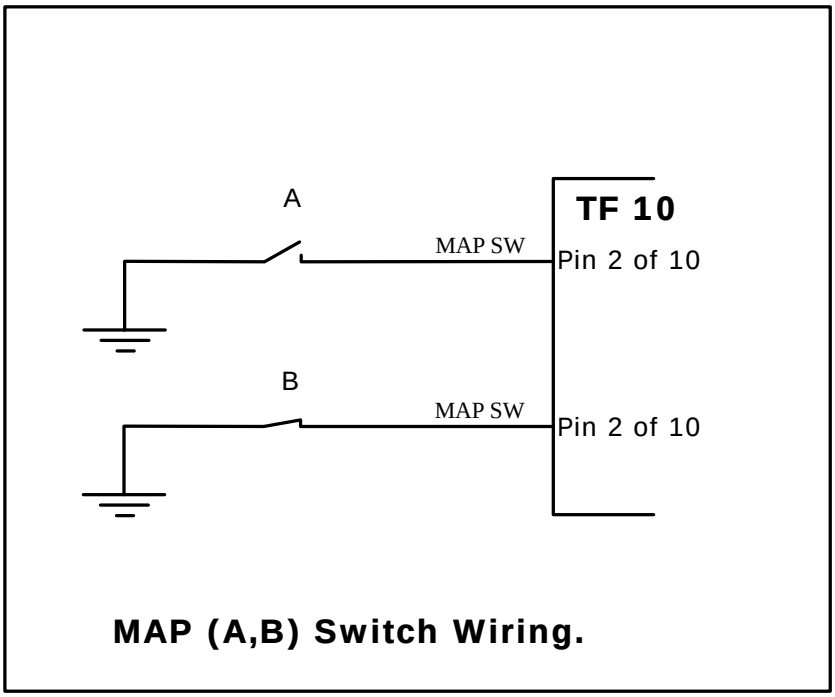
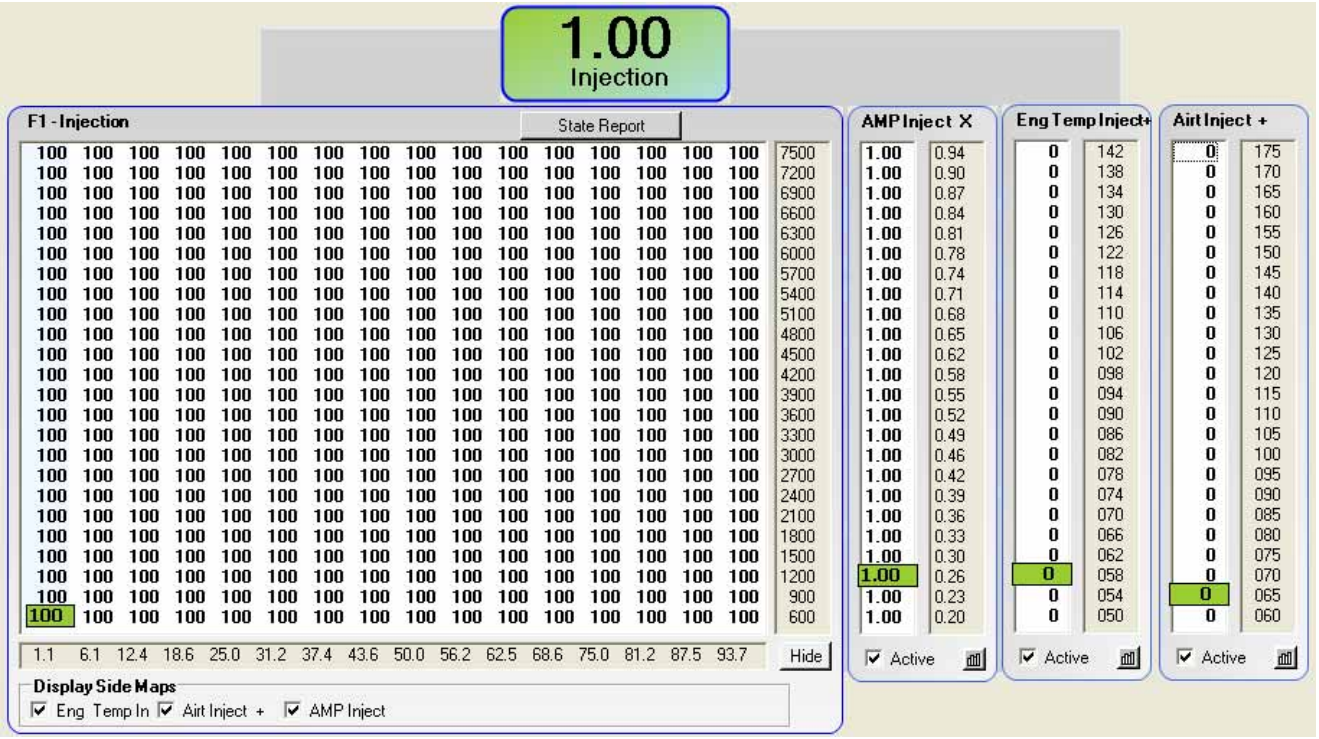


FIGURE 13.: MAP SWITCH WIRING DIAGRAM

5.9 INJECTION

The TF10 has TWO injector drive outputs. Each output can drive up to 10A in either straight or PEAK+HOLD mode. The output-operating mode is set via the LetRipp Windows Tuning Software under "CONFIG, SYSTEM DEF", and ticking the appropriate box.

The injector activation is mapped via:



1) **Main Map:**
   384 sites, RPM and TPS, entry is in COUNTS, i.e. 100 Counts = 1.0 ms
2) **Optional:**
   a. AIR Temperature side map: 24 sites, entry in counts
   b. Engine Temperature side map: 24 sites, entry in counts
   c. AMP side map: 24 sites, entry in counts

Air and engine temperature values are added but the AMP values are multiplied to form the final injection length. Negative values can be entered in the side maps, but a negative computation results in ZERO injection, and a fault will result.

5.9.1 INJECTION WIRING

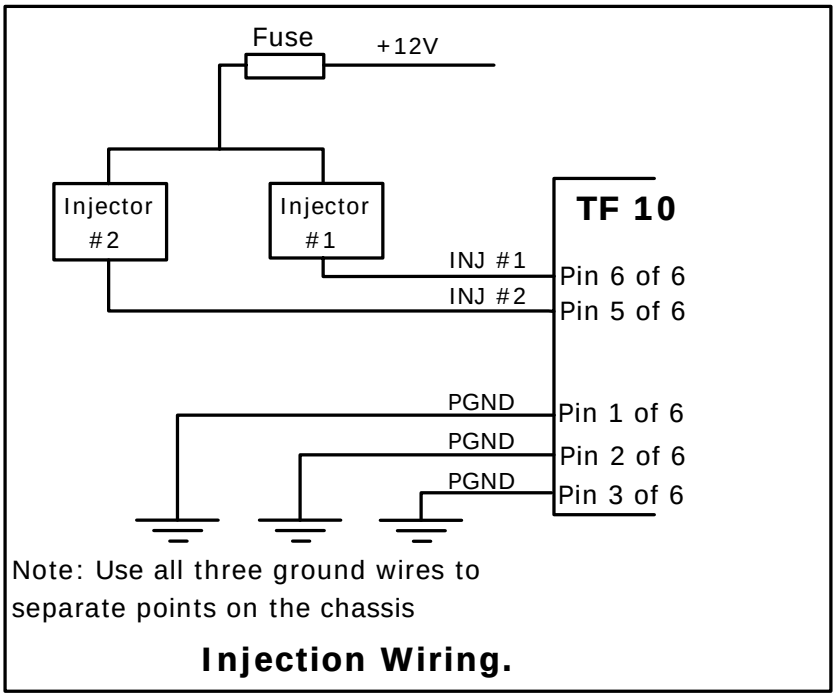


FIGURE 14.: INJECTION WIRING DIAGRAM

NOTE: The size of the Fuse in this wiring setup is dependant on the injectors used.

6 BOOST CONTROL

The FT10 has a boost control feature, which can be used to IMPLEMENT a boost control loop after adding a turbo.

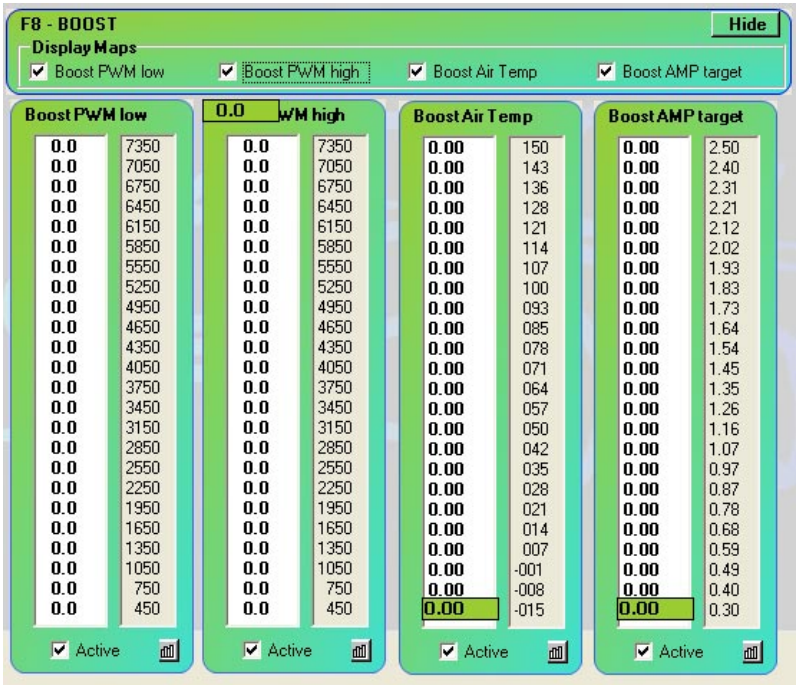
This does NOT MODIFY an existing boost control loop, but constructs a new one. The manifold pressure is measured via the AMP (IN) (pin 8 of 10) and compared to a target map. Depending on the difference to the target boost pressure the output PWM to the bleeder solenoid is modified so that the waste gate is closed/opened to achieve the target pressure.

6.1 PURPOSE

It is often desirable to add a turbo to an engine without DE-COMPRESSING the engine. In this application precise boost control is required at lower RPM to avoid knocking, but higher boost pressures can be used at high RPM.

The boost control is achieved via a “BLEEDER” valve, which controls the effective canister pressure, and thus operates the waste gate. The signal to the bleeder valve is PWM.

6.2 BOOST CONTROL MAPS AND PARAMETERS



BOOST TARGET MAP
Entry is in pressure (bar/lbs). For each RPM point a different boost target can be specified.

BOOST AIR TEMPERATURE
The entry is in percent (of PWM). The value is added/subtracted from the PWM base.

BOOST LOW PWM
This is the PWM BASE duty cycle in percent for LOW TPS settings.

BOOST HIGH PWM
This is the PWM BASE duty cycle in percent for HIGH TPS settings.

BOOST GAIN (PARAMETER)
This is a multiplier (0.01 to 9.99) by which the target to manifold difference is multiplied with before adding the result to the BASE PWM. If the actual manifold pressure differs too much from the target then the gain is too low. If the loop 'oscillates' then the gain is too high. The gain depends on the bleeder valve construction, the size of the waste gate canister, and the piping used.

Parameters Map showing the Boost Gain setting:

6.3 WASTE GATE CANISTER

A waste gate canister with a pressure of less or equal to the LOWEST boost pressure must be used. Normally 0.2-0.3 bar (3.5lb) is sufficient.

NOTE: Maps can be DE-ACTIVATED, or zeros can be entered.

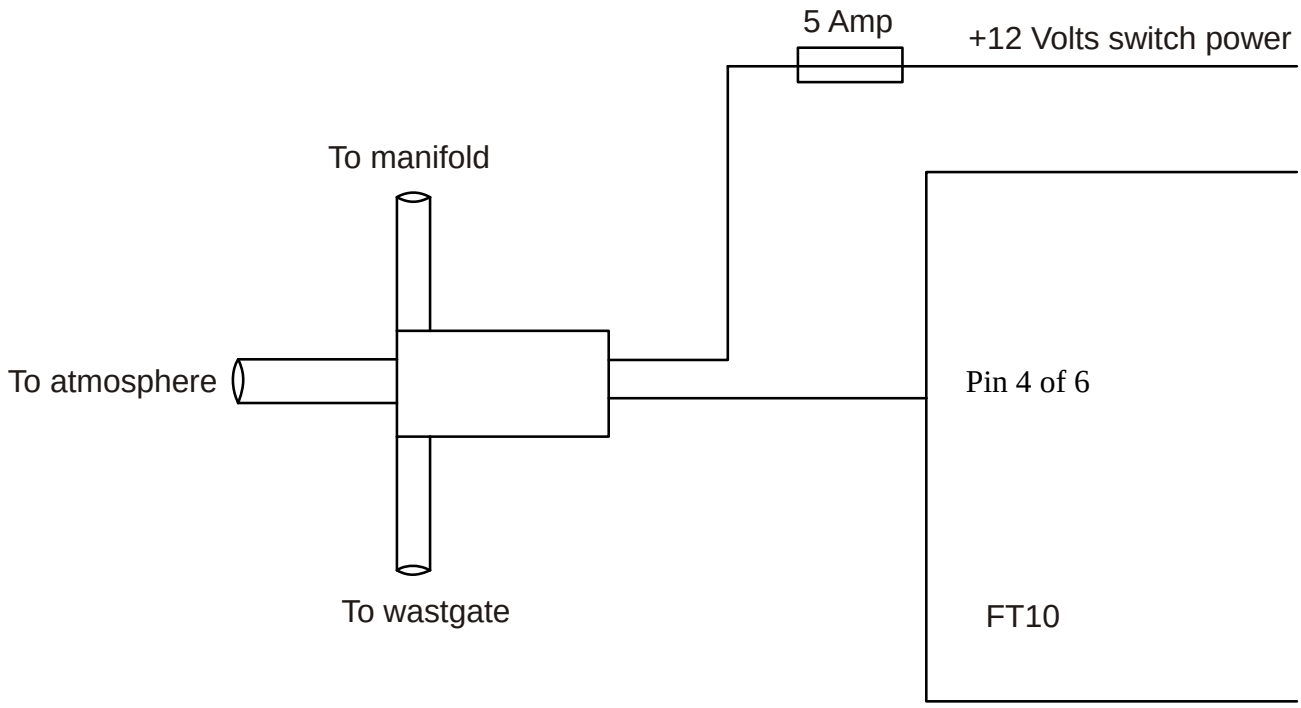


FIGURE 15. DIAGRAM OF TYPICAL BOOST SOLENOID

6.3.1 BOOST CONTROL OUTPUT WIRING

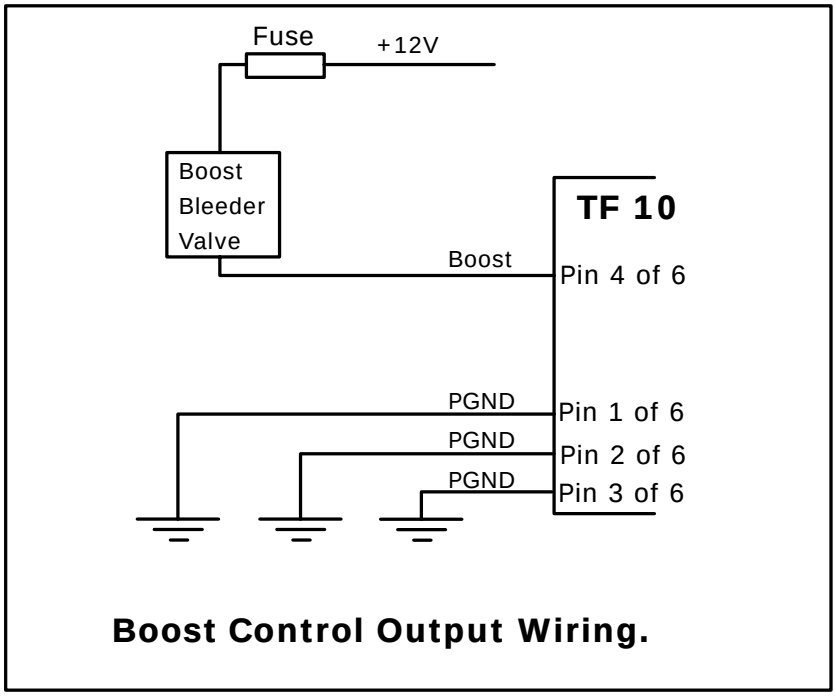


FIGURE 16.: BOOST CONTROL OUTPUT WIRING DIAGRAM

6.4 ANALOG SIGNAL MODIFICATION

The TF10 can modify two ANALOG SIGNALS, such as TPS, Airflow, MAF, or Temperature signal. The analog signals must be in the range of 0-5Volts. In addition to mapping the analog output to achieve the desired effect, the output can be limited or clamped at a certain voltage.

6.5 USAGE

An analog signal is a DC voltage generated from a number of different types of sensors, examples of these are the air flow meter, mass air flow meter (MAF) and pressure transducer (MAP) or temperature transducer.

Most analog signals, with a few exceptions, range from 0 to 5 Volts and are used by the ECU to determine the fuel quantity. By routing the signal through the TF10 the analog voltage is changed, which in turn results in a fuel change. Thus, allowing the car to be tuned. The input to output voltage relationship can be changed at various engine-operating points. This process is called “MAPPING”.

6.5.1 ANALOG SIGNAL WIRING

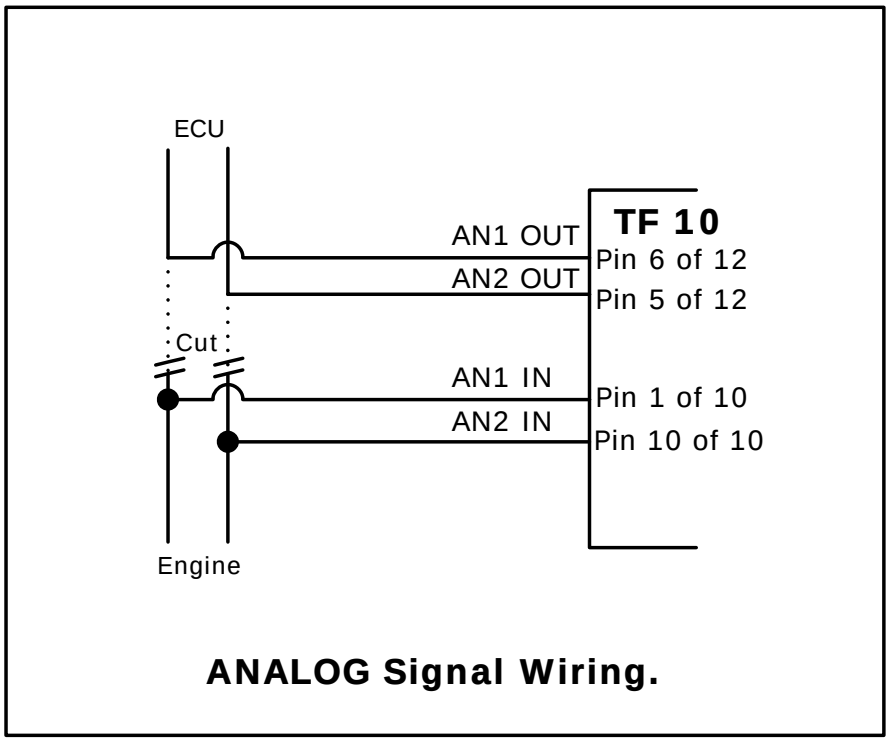


FIGURE 17.: ANALOG SIGNAL WIRING DIAGRAM

The Analog INPUT can be MAPPED to the ANALOG OUTPUT by the following:

6.6 REQUIREMENTS

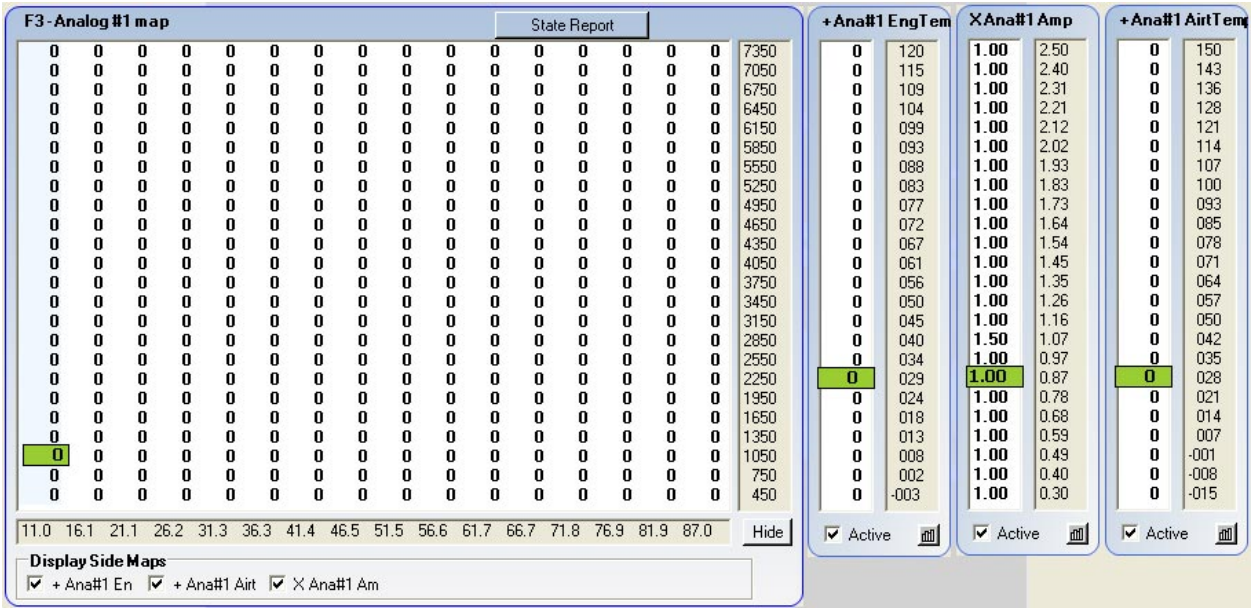
1) ANALOG #1 Lower limit (Volts):
   This voltage setting prohibits the analog output to go BELOW the limit.
2) ANALOG #1 High limit (Volts):
   This voltage setting prohibits the analog output to go ABOVE the limit
3) ANALOG #1 Zero (Volts):
   This voltage offsets the ANALOG output voltage by the entered voltage.

Calculations:

All Analog Map values are added together to form the analog modification. This is then applied to the input reading, limited if necessary, and output to the Analog output pin.

7 ANALOG #1 MODIFICATION

The TF10 ANA1 feature can modify one analog signal, namely ANALOG #1 INPUT and output the mapped signal on ANALOG #1 OUT.



1) **Main ANALOG map:**
   384 sites via TPS and RPM, entry in counts i.e. 100 counts = 1.0 Volts
2) **Optional:**
   Air Temperature: 24 sites via Air Temp, entry in counts, i.e. 100 counts = 1.0 Volts
   Engine Temperature: 24 sites via Engine Temp, entry in counts
   AMP: 24 sites via AMP, entry in counts

NOTE: All Maps can have positive or negative entries!

7.1 COMPLETE CALCULATION

ANA1OUT = ANA1IN
+- ANA1 MAP
X AN1 AMP
+- AN1 ENGT
+- AN1 AIRT

The ANA1OUT signal is limited to the low and high limits.

Note: The AMP map is a multiplier so when it is not used set all the values to 1.0

The Analog 2 channel is calculated in the same manner.

8 CONCLUSION

All the information that is required for a successful installation of the TF10 has been included in this Technical Manual. Should you experience any problems or require any technical assistance, please do not hesitate to contact us at info@perfectpower.com.