FuelTech

GEARCONTROLLER

Gear Change Ignition Cut Module

Installation and Operation Guide

Summary

1. Presentation 4
1.1 Characteristics 4
2. Warnings and Warranty Terms 5
3. Installation 6
3.1 Electric Connections 6
3.2 Connector Diagram 7
3.3 Strain Gage 7
3.4 Line Lock 7
4. Navigation and Setup 8
4.1 Menu Navigation 8
4.2 Dashboard 8
5. GearController Setup 9
5.1 TPS Calibration 10
5.2 Output Test 10
5.3 Protection and Password Setup 10
5.4 Software Version 10
6. Datalogger Connection 11
7. Gear Shift Setting 12
8. Launch Procedure for Drag Racing Cars 13
8.1 GearController and boost pressure control (BoostController) 13
9. Full Wiring Schematic 14

1. Presentation

This equipment was developed for competition vehicles with the purpose of allowing gear shifting in manual transmissions (sequential or not) without using the clutch (flat shifts). It can only be used on gearboxes equipped with quick shifters (Liberty Pro-Shift, Liberty Face Plate, Dog Engagement, etc.). Synchronized gear boxes do not allow correct shifting using GearController.

The module works on "Power Shift" mode, making progressive cuts to the ignition in order to reduce the engine's power by a fraction of a second, facilitating the disengagement of the current gear and the linkage of the next gear.

This equipment can only be used with FuelTech ECUs line (FT200, FT300, FT400 and 3eTech) only, due to the type of ignition cut developed especially for this type of application.

The correct functioning of this product can only be achieved if:

- **The driver stops forcing the gear shift lever when a gear is engaged. If the driver continues to force the lever after shifting the gear, undesired cuts may occur.**
- **The gear shift has the capacity to maintain itself engaged even if the lever is not being pressed anymore.**

WARNING ON MSD DIS-4: GearController cannot be used when an MSD DIS-4 ignition module is installed. When the GearController sends a signal to cut the ignition, the DIS-4 interprets it as loss of RPM signal and cuts the ignition for a period longer than the desired, preventing the correct functioning of the equipment.

1.1 Characteristics

Specifications and Inputs

2 strain sensor inputs (strain gage)

Two-step button input

Clutch switch input

Two-step button output

BoostController stage increase output

Line Lock solenoid control output

Dimension: 140mm x 80mm x 30mm

2. Warnings and Warranty Terms

The use of this equipment implies the total accordance with the terms described in this manual and exempts the manufacturer from any responsibility regarding to product misuse.

Read all the information in this manual before starting the product installation.

This product must be installed and tuned by specialized auto shops and/or personnel with experience on engine preparation and tuning.

Before starting any electric installation, disconnect the battery.

The inobservance of any of the warnings or precautions described in this manual might cause engine damage and lead to the invalidation of this product warranty. The improper adjustment of the product might cause engine damage.

This product does not have a certification for the use on aircrafts or any flying devices, as it has not been designed for such use purpose.

In some countries where an annual inspection of vehicles is enforced, no modification in the original fuel injection system is permitted. Be informed about local laws and regulations prior to the product installation.

Important warnings for the proper installation of this product:

- Always cut the unused parts of cables off – NEVER roll up the excess as it becomes an interference capturing antenna and it can result on equipment malfunction.

- The black wire in the cable MUST be connected directly to the **battery's negative terminal**, as well as each one of the sensors' ground wires.

- The black/white wire MUST be connected directly to the engine block or head. By doing so, many interference problems are avoided.

Limited Warranty

This product warranty is limited to one year from the purchase date and covers defects from manufacturing origin only.

Defects and damages caused by the misuse of this product are not covered by the warranty.
This module has a serial number that is linked to the purchase invoice and to the warranty. In case of product exchange, contact FuelTech.

The violation of the seal results in the invalidation of the Product Warranty and the loss of any access to new upgrade releases.

The correct functioning of this product can only be achieved if the driver stops forcing the gear shift lever when a gear is engaged. If the driver continues to force the gear shift lever after engaging a gear, undesired cuts may occur.

The gear shift has the capacity to maintain itself engaged even if the lever is not being pressed anymore.

Manual version 2.2 – July/2012

3. Installation

For proper installation, the electric cable must be disconnected from the module and the vehicle's battery. It is very important that the cable length is the shortest possible and that exceeding unused parts of wires are cut off.

Choose an appropriate location to affix the module inside the car, and avoid passing the harness wires close to the ignition wires and cables, ignition coils and other sources of electric noise.

The black wire in the harness is the signal ground wire, and must be connected to the battery's negative terminal. The black/white wire is the power ground wire, and must be connected to the vehicle's chassis.

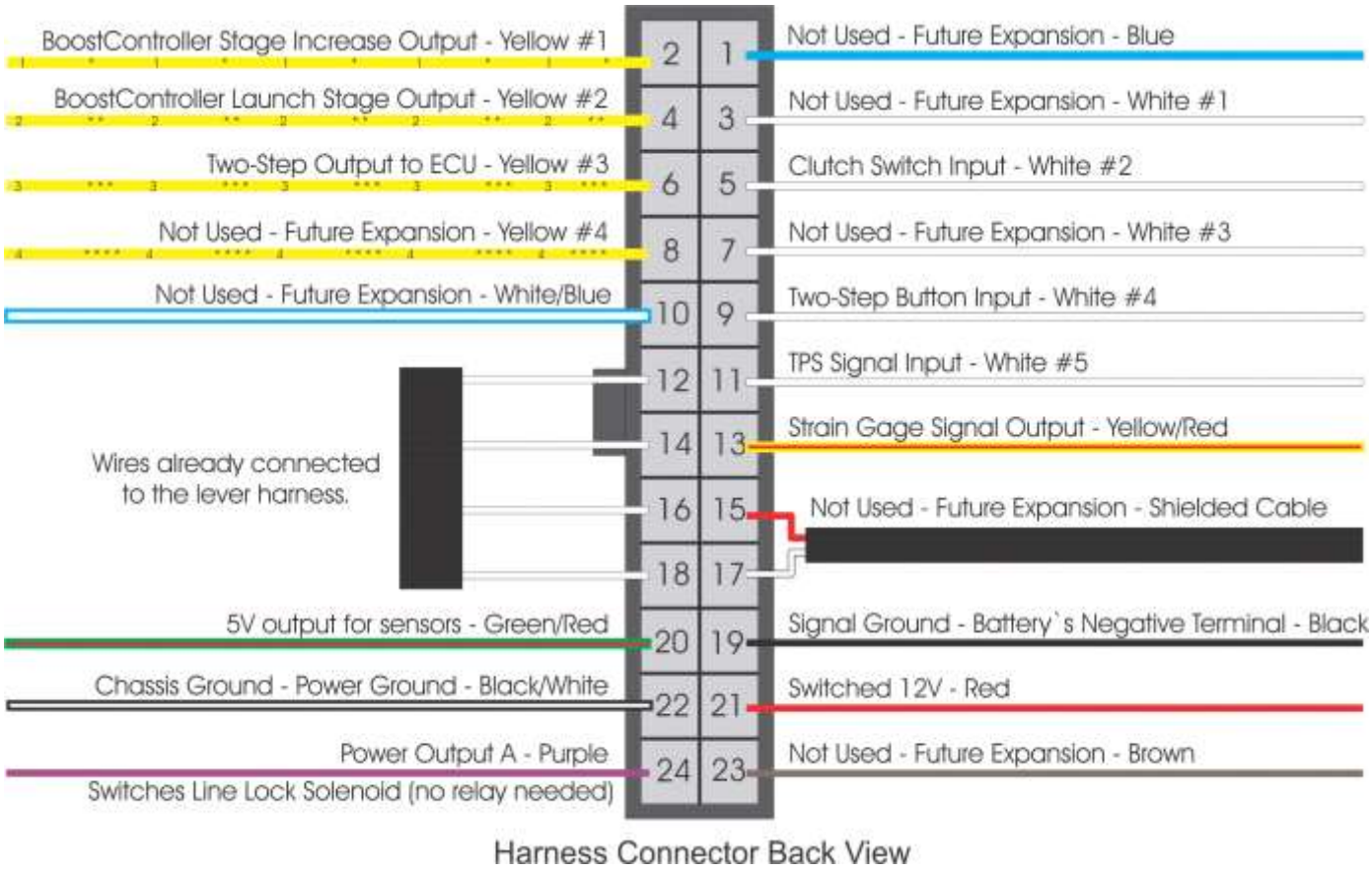
The electric cables must be protected from contact with sharp parts on the vehicle's body that might damage the wires and cause short circuit. Be particularly attentive to wires passing through holes, and use rubber protectors or any other kind of protective material to prevent any damage to the wires.

IMPORTANT: the lever harness installed by FuelTech should not be cut, jointed or welded. Any modification to these wires will affect the GearController operation.

3.1 Electric Connections

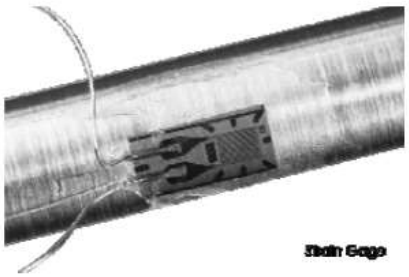
Wire color	Pin	Connection	Notes
Blue	1	Future Expansion	Not used – Do not connect
Yellow #1	2	BoostController stage increase output	Connect to BoostController white wire Stage increase signal (optional use)
White #1	3	Future Expansion	Not used – Do not connect
Yellow #2	4	BoostController launch stage output	Connect to BoostController pink wire (optional)
White #2	5	Clutch switch input	Connect to clutch switch. Negative activated (optional)
Yellow #3	6	Two-step output to ECU Ignition cut	Connect **only** this wire to FT two-step input (FT ECU blue wire)
White #3	7	Future Expansion	Not used – Do not connect
Yellow #4	8	Future Expansion	Not used – Do not connect
White #4	9	Two-step button input	Connect **Only** this wire to the two-step button. Negative activated input.
White/Blue	10	Future Expansion	Do not connect
White #5	11	TPS signal input	TPS signal. Splice with FT ECU orange wire.
4-way shielded cable White	12	Lever Sensor	Already connected to lever harness
Yellow/Red	13	Strain gage signal output	0-5V analog output that informs the signal of the force applied to the lever. Connect to Datalogger input.
4-way shielded cable Blue	14	Lever Sensor	Already connected to lever harness
2-way shielded cable Red	15	Future Expansion	Not used – Do not connect
4-way shielded cable Orange	16	Lever Sensor	Already connected to lever harness
2-way shielded cable White	17	Future Expansion	Not used – Do not connect
4-way shielded cable White	18	Lever Sensor	Already connected to lever harness
Black	19	Battery negative	Connected **directly** to battery`s negative terminal. **Cannot** be connected to chassis. No seams or splits.
Green/Red	20	5V output for sensors	5V output to TPS and other sensors
Red	21	Switched 12V Input	Use 5A fuse
Black/White	22	Chassis Ground	Power ground, connected to the chassis
Brown	23	Future Expansion	Not used – Do not connect
Purple	24	Power output - A	Activates Line Lock solenoid. Sends negative signal (optional)

3.2 Connector Diagram



Harness Connector Back View

3.3 Strain Gage



This is the main sensor used by GearController to control the engine and engine cuts. *Strain gage* is capable of measuring the force applied on the gear shift lever by the driver at the time of the gear shifting and sending it to the GearController. According to the intensity of the signal, the module performs an ignition cut, allowing the disengagement of the current gear and the engagement of the next one without using the clutch (only in quick shift equipped gearboxes).

Installation of this sensor must be made done by FuelTech personnel at the factory only, that is, it is necessary to send the gear shift lever to FuelTech for installation of the *strain gage*.

3.4 Line Lock

A largely used accessory in drag racing cars is the *Line Lock* solenoid. It is used to block the vehicle's wheels, stopping them from moving the car when it`s aligned at *Stage* and *Pre-Stage*. It is also used in rear wheel drive cars to facilitate burnout.

The GearController releases the *Line Lock* at the same time the clutch is released improving the car launch.

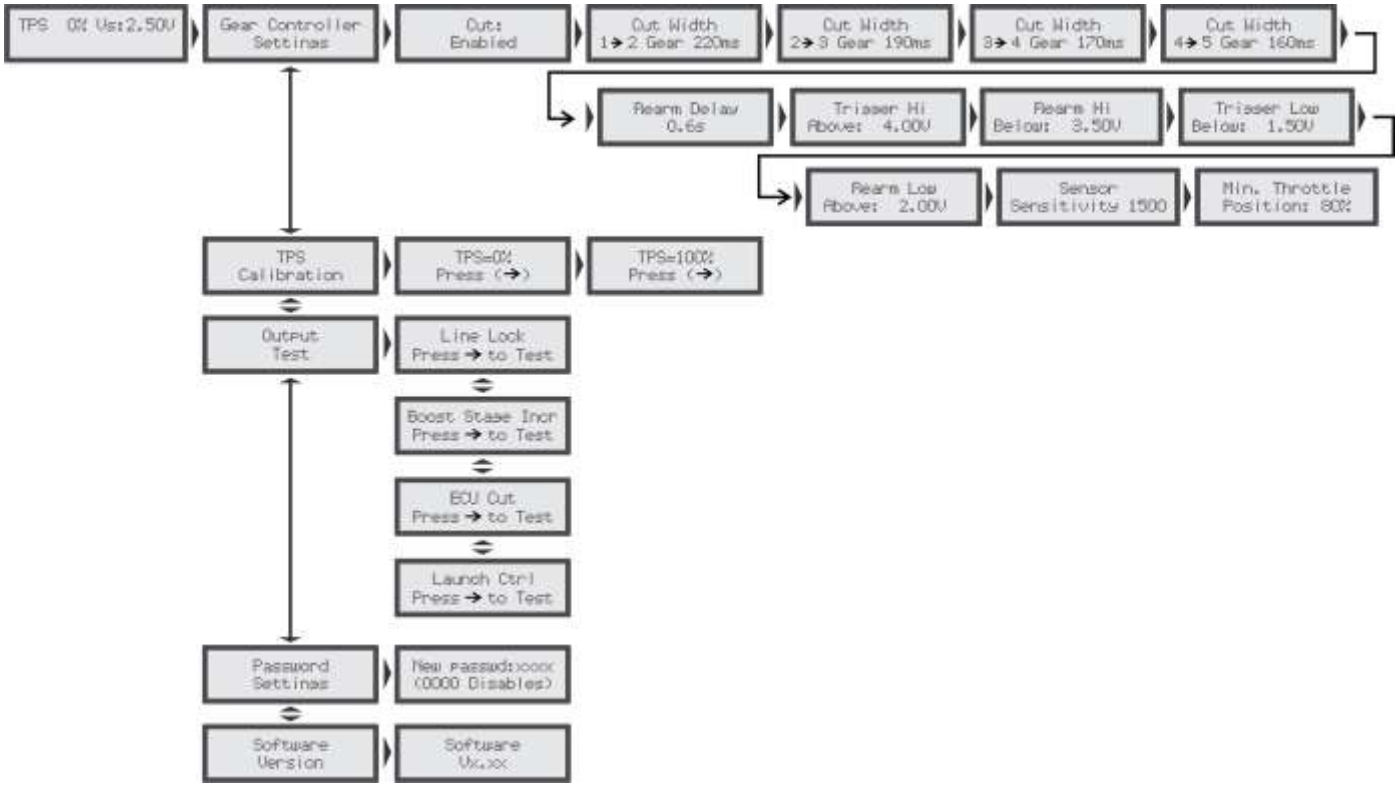
There is no need for a relay to control this solenoid. The GearController line lock output is capable of support the solenoid's high current.

4. Navigation and Setup

4.1 Menu Navigation

To navigate the menus and setup GearController, 4 buttons are used (left, right, up and down).

- Left Button: **back or cancel**;
- Right Button: **advances** or **confirms** menu options;
- Down Button: **navigates down** or **reduces** the parameters of each menu item;
- Up Button: **navigates up** or **increases** the selected values of a menu item.



4.2 Dashboard

TPS: is the throttle position sensor readout.

Vs: voltage on the strain gage sensor. When forcing the lever in one direction, the voltage value increases. Forcing to opposite direction, the value decreases.

3rd Gear: counter that is increased at every gear shift. It counts from 1st to 5th gears and then, counts 6th Cut, 7th Cut... This counter is very useful because if GearController shows that more cuts were made than gears, it means something is activating the cut needlessly and a GearController configuration review is necessary.

In certain moments other messages are shown on the dashboard screen:

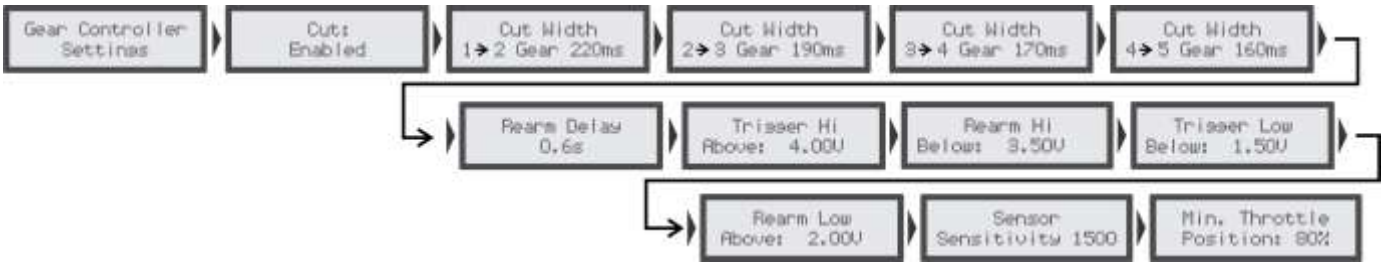
L. Lock: this is shown when pressing the two-step button, indicating that the Line Lock Output is activated.

Two-Step: indicates that the two-step button input and the two-step output to ECU are activated. Usually this is shown during launch procedures (Refer to chapter **Erro! Fonte de referência não encontrada.** of this manual).

Cut: is shown when GearController makes an ignition cut while shifting gears.

Boost: appears when, while shifting gears, GearController sends a pulse at BoostController stage increase input.

5. GearController Setup



Cut: when selecting "Disabled" GearController does not make ignition cuts when the shifter is operated. The two-step function and line-lock functions will work normally when the two-step button is pressed.

Cut Width: width of the ignition cut, configurable by gear. We recommend to start with a value above 250ms and to decrease it until, when pulling the lever, the engine gets a cut, but the gear is not engaged. At this point, increase about 10 or 20ms in Cut Width. Cuts made after 5th gear will have duration equal to the last cut.

Rearm Delay: after a gear shifting the GearController waits the configured delay in this parameter to re-enable the system to a new cut. In case the driver tries to engage another gear or keeps forcing the lever after the engagement, the module will not make a new cut before such time (**0,6s recommended**).

Trigger Hi: when forcing the lever in **one direction**, the voltage sent to GearController by the *strain gage* goes above 2.5V. This value indicates the voltage that the *strain gage* must reach to make the engine cut.

Rearm Hi: this helps to stop unnecessary cuts in case the driver keeps forcing the lever after engaging a gear. This parameter must be setup with a value slightly **above** the "Vs" value shown on the GearController Dashboard. It means the voltage of the lever sensor must drop below this value to rearm the system to a new cut.

Trigger Low: when forcing the lever the **other direction**, the voltage sent to the module by *strain gage* goes below 2.5V. This parameter indicates the voltage *strain gage* must reach to make the engine cut.

Rearm Low: this helps to stop unnecessary cuts in case the driver keeps forcing the lever after engaging a gear. This parameter must be setup with a value slightly **below** the "Vs" value shown on the GearController Dashboard. It means the voltage of the lever sensor must be above this value to rearm the system to a new cut.

Sensor Sensitivity: this parameter is used to adequate the type of lever to *strain gage*. The more **stiff** the **lever,** its flection will be **smaller** while shifting gears, therefore **smaller** the voltage sent by *strain gage* to GearController. In this case, the parameter "Sensor Sensitivity" must be **increased**. On the other hand, the more **flexible** the lever, **higher** the **voltage** sent by *strain gage*. In this case, the parameter "Sensor Sensitivity" value must be **decreased**.

We recommend a '1500' value as initial parameter, but it is important to observe the voltage levels of the lever force signal in the Datalogger. If during the gear shifts this signal reaches 5V or 0V, the parameter "Sensor Sensitivity" value must be decreased until the values are near the limit, without reaching it.

If this parameter is configured incorrectly, GearController may cut the engine as soon as the driver touches the lever, before moving it.

NOTE: Every time this parameter is altered it is necessary to reboot GearController so a new calibration of the strain gage can be made automatically. Avoid touching the lever when rebooting the equipment, for it can interfere with the calibration.

Minimum Throttle Position: this parameter only allows GearController to make an ignition cut if TPS value is above this configuration. This avoids the cut to be activated in undesired situations, for instance, when maneuvering the car or driving normally (**80% recommended**).

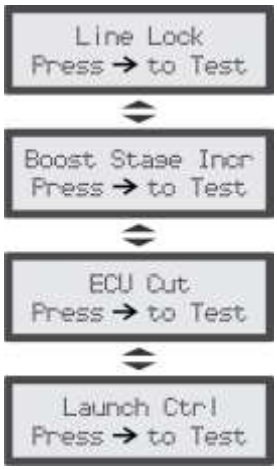
Remember: if the driver lifts the gas to shift gears and the TPS value drops below this configuration, GearController will not make the ignition cut.

5.1 TPS Calibration

The first position to be calibrated is the idle speed. Press the right button with the pedal in rest position. For second position, press the pedal all the way and press the right button again.

5.2 Output Test

This menu is used to check if GearController installation is correct by testing its outputs.



Line-Lock Test: activates Line Lock solenoid (Purple wire, pin 24 – sends negative signal). While the right button is pressed, Line Lock solenoid is active.

Stage Increase Test: tests the BoostController stage increase output (sends negative signal). When pressing the right button BoostController should increase one stage on BoostController.

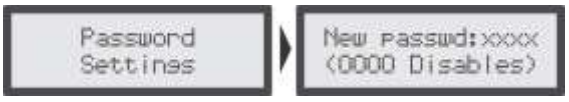
Cut Test: tests FT ECU two-step input, activating the cut (sends negative signal). While the right button is pressed the ECU two-step function is active.
Remember: It is needed to rev the engine above the two-step RPM. Otherwise, no ignition cut will be performed.

Launch Test: tests the BoostController launch stage (sends negative signal). While the right button is pressed, BoostController must indicate stage "0" and show the programmed launch pressure. This function only works when BoostController is configured in Sequential mode.

5.3 Protection and Password Setup

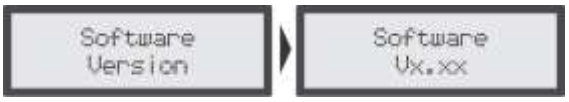
Protection password can only be accessed with the engine turned off. By enabling the protection password, you avoid others to have access to the device's configurations because the menu is disabled.

When blocked, the device operates with the saved configurations, not being possible to modify them without having the password



Important Note: The password is factory disabled. When enabling a protection password you will block the access of others to the equipment and maybe even yours. Chose a password you are certain to remember because, for safety reasons this password can only be removed by sending the module to FuelTech, along with the purchase receipt/invoice.

5.4 Software Version



In this menu you can check the software version installed in the processor and the equipment's serial number. Every time you contact technical support, have these numbers in hand to facilitate the service.

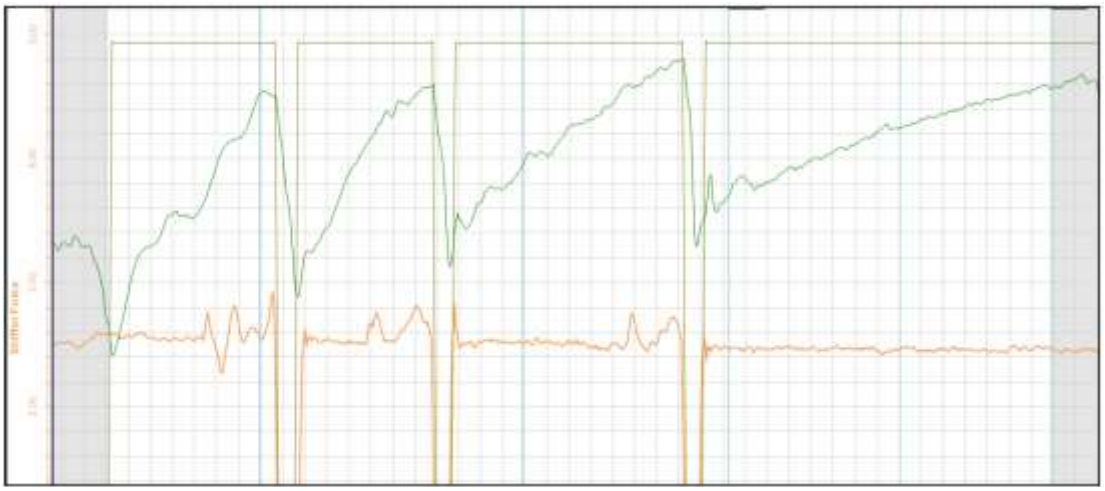
6. Datalogger Connection

To monitor functioning of GearController, a PRO24 Datalogger or a WB-O2 Datalogger can be used, connected to the signals indicated below:

Connector Pin/Wire Color	Function	Description
Pin 13 Yellow/Red Wire	Strain gage force signal	This is the main signal that must be logged in order to adjust GearController basic settings. It shows the force applied to the lever by the driver.
Pin 5 White Wire #2	Clutch switch	When at 0V, indicates that the clutch is pressed. When back at 5V, shows the launch moment.
Pin 6 Yellow Wire #6	Two-step output to ECU Ignition cut signal	Signal indicating the cut made by GearController
Pin 9 White wire#4	Two-step button	Signal to verify when the driver pressed the two-step button

These are analog channels and must be connected to the white inputs of PRO24 Datalogger or the analog inputs of WB-O2 Datalogger (white, blue, pink or orange wires). These inputs are configured as "0-5V Linear Sensor" in FuelTech Datalogger software. When they are at 0V, it means they are active.

With these signals is possible to obtain a graph similar to the example below:



The light green line shows engine RPM. Note that at every gear shift it drops according to the engaged gear.

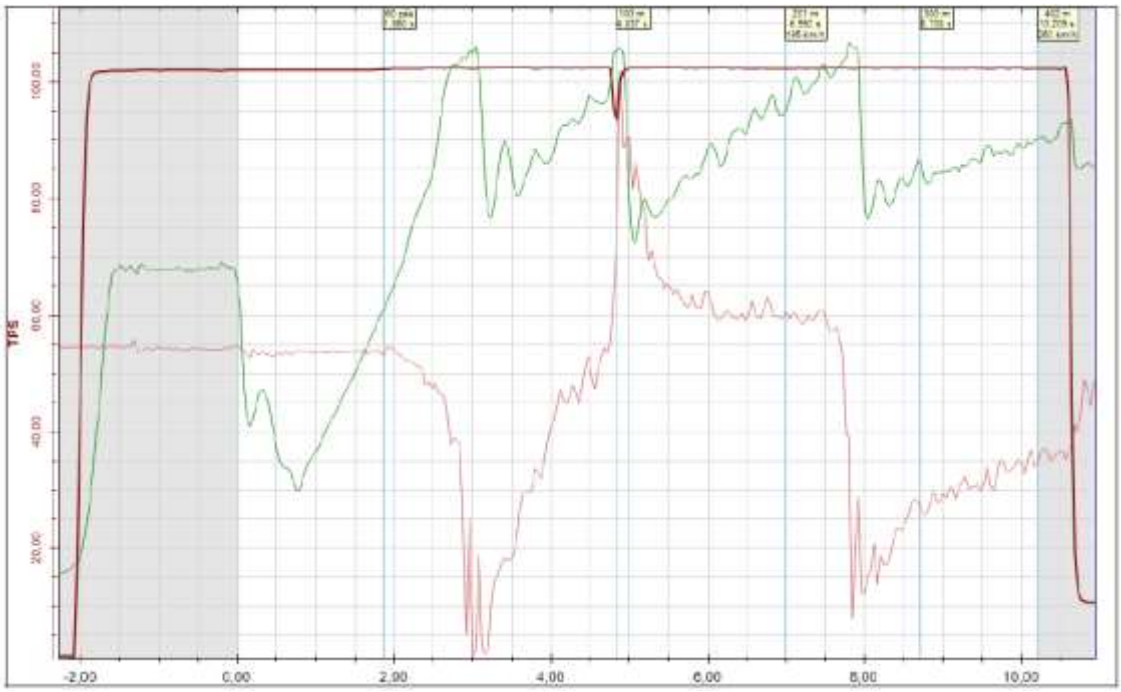
The orange line shows the force the driver is applying to the lever. In this case the shift is sequential and the lever changes the gears being pushed in the same direction, because the lever voltage varies in the same manner.

The dark green line shows the signal sent to make the engine cut, through the injection two- step input. When the lever is moved to shift gears, the Two-step ECU output is activated and sends a pulse for injection input.

7. Gear Shift Setting

After installing and connecting the GearController to a Datalogger, a run with the car can be made and logged to analyze GearController functioning.

It is possible to note in the graph below that the driver shifted practically all gears with wide open throttle.



Also note the highlighted TPS line, practically at 100% at all times.

The next image is from the same log, only showing the strain gage voltage with the correct configurations according to the voltage levels recorded in the log.

Trigger Hi: must remain a little below the voltage peak reached by the lever during shift;
Rearm Hi: its voltage value remains a little above the strain gage rest voltage (2.50V);
Trigger Low: configured with value a little above the inferior lever force peak during shift;
Rearm Low: its voltage value remains a little below the strain gage rest voltage (2.50V);

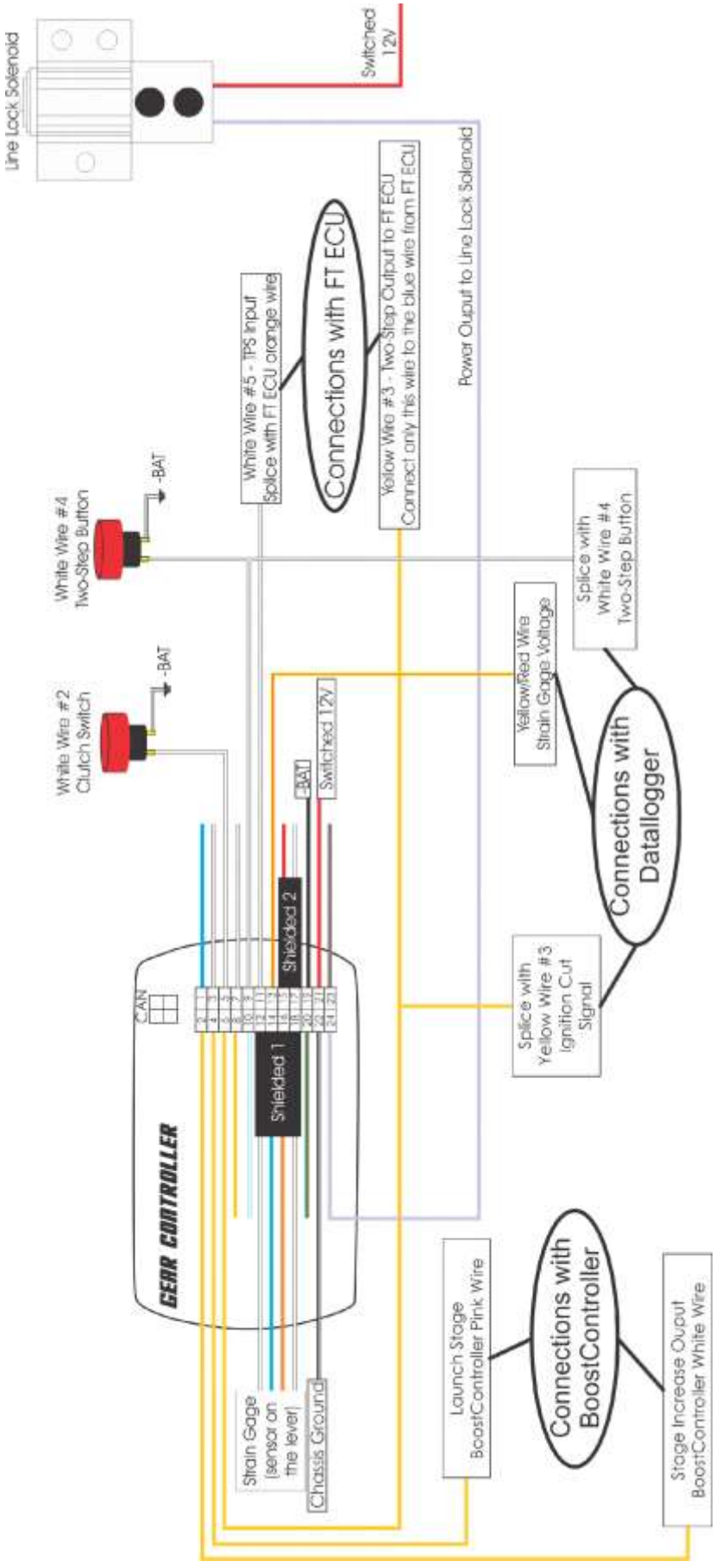
8. Launch Procedure for Drag Racing Cars

- When stopping at the start line *(pre-stage)*, keep the clutch and the brake pressed.
- Press and Release the two-step button to activate the system. Doing that, the GearController:
  - Activates line lock solenoid;
  - Activates BoostController launch stage;
  - Activates the two-step output to ECU;
- Proceed to final alignment *(stage)*. It is important that the clutch switch, allows the driver to advance to the *stage* without need to be deactivated. If this is not possible or, if occurs, keep the two-step button pressed, but release it before the clutch.
- At the moment the clutch is released and deactivate the clutch switch, the GearController will automatically:
  - Instantaneously releases line lock;
  - Activate BoostController 1st stage;
  - Deactivate the two-step output to ECU;
- At the end of first gear, **the driver must shift gears normally**, as he would do before the installation of GearController but, **without clutching or lifting the throttle**. The important thing is to make a uniform force on the lever; it does not have to be excessive, but strong enough to ensure the engagement of the next gear. It is **important** that after the shift the **driver releases the lever** (stop forcing it).
- When the strain gage voltage reaches the level of "Trigger Hi" or "Trigger Low" configured in GearController, the unit will make an ignition cut with the width configured in "Cut Width" parameter and with this, the engine will momentarily decelerate, allowing the current gear to be disengaged and the next gear to be engaged.

8.1 GearController and boost pressure control (BoostController)

The GearController module was developed to be used with FuelTech BoostController, increasing the boost stages along with gear shift.

The shift occurs in a fraction of a second, practically unnoticed, largely improving the vehicle drive. In dragster cars, the use of quick shift gearboxes, added to electronic booster, stops the car from losing traction while shifting gears, especially in the first meters of the track.

Note: BoostController must be configured in Sequential mode with stage increase by gear (not by time).

9. Full Wiring Schematic