Leonardo 175 Setup

TYPE OF PETROL TO ALT. FUEL SWITCH-OVER

Indicates to the LEONARDO ECU how the petrol-to-alternative fuel switchover is to occur.

DECELERATION BY USING TPS

The switchover from PETROL to ALTERNATIVE FUEL occurs after the engine has gone beyond the preselected RPM threshold and the TPS is at an idle value.

ACCELERATION

The switchover from PETROL to ALTERNATIVE FUEL occurs in acceleration when the engine goes beyond the preselected RPM threshold.

DECELERATION BY USING RPM

The switchover from PETROL to ALTERNATIVE FUEL occurs after the engine has exceeded the preselected RPM threshold and there is a decrease in engine RPM (deceleration).

ALTERNATIVE FUEL START

The LEONARDO ECU starts the engine directly on the alternative fuel by opening the alternative fuel lock-offs when it senses engine RPM.
This option is recommended for CARBURETED vehicles.

PETROL TO ALT. FUEL SWITCH-OVER RPM

This is the number of engine RPM that determines the threshold for the fuel switchover.
This option is NOT utilized with the ALTERNATIVE FUEL START.

DURATION OF FUEL OVERLAP

If the two YELLOW wires of the LEONARDO are utilized in order to disable injection, it is possible to delay the engagement of the fuel injection while the alternative fuel electrovalves are opening. This allows the alternative fuel to leave the regulator and reach the intake manifold while the engine is still operating on petrol, thus avoiding carburetion holes and possible backfires. For this reason, during the fuel switchover, there is a short overlap of the two fuels. The fuel overlap time is adjustable between 0-5 seconds.
This option is NOT utilized with the ALTERNATIVE FUEL START.

PRIMER DURATION

Indicates how long the ALTERNATIVE FUEL electrovalves stay open when the ignition key is turned on. This option is displayed ONLY when the ALTERNATIVE FUEL START is selected.
The priming time is adjustable between 0-5 seconds. The use of the primer is necessary for carbureted vehicles in order to facilitate start-ups. This is achieved by opening the alternative fuel electrovalves for a predetermined amount of time so that the fuel can reach the intake manifold before the engine is started.

T.FUEL START

Leonardo 175 Setup

TYPE OF ALTERNATIVE FUEL LEVEL INDICATOR

Indicates to the LEONARDO ECU the type of alternative fuel level sensor that is utlilized on the vehicle.

AEB

Select this option if any AEB type LPG or NATURAL GAS sensor (either "optic" or "resistor" type) is used.

0-90 OHM

Select this option for any LPG sensor with a variable resistance from 0 OHM (empty) to 90 OHM (full).

NON STANDARD

Select this option if an LPG or NATURAL GAS resistor type sensor with a DIRECT variable signal (ohmmic value) is used. This value must be low on empty and high on full.

NON STANDARD INVERTED

Select this option if an LPG or NATURAL GAS resistor type sensor with an inverted variable signal (ohmmic value) is used. This value must be high on empty and low on full.

In a case where the NONSTANDARD resistor type sensor is used, it is necessary to verify first of all if the signal is DIRECT or INVERTED. To this end, it is necessary to access the second page of DATA DISPLAY (Fig. 13) and read the LEVEL readout.

If with a full tank the value of LEVEL is high (about 200), the sensor is of the DIRECT type, thus NONSTANDARD must be entered. If the value of LEVEL is low (about 10), the sensor is INVERTED, thus NONSTANDARD INVERTED must be entered.

After the above has been established, it is necessary to enter the correct references for LOW, ¼, 2/4, ¾, and full by proceeding as follows:

- Have pen and paper ready.
- Move the sensor's indicator manually, starting form the full position and writing the corresponding number for each reference mark (EMPTY, LOW, ¼, etc.).
- Enter the values that have been noted in the corresponding areas by means of the hand-held tester.

FULL TANK LEVEL = value of LEVEL with a full tank. The four green LEDs are on.

3/4 REFERENCE = value of LEVEL when the 4/4 LED goes out.

2/4 REFERENCE = value of LEVEL when the ¾ LED goes out.

1/4 REFERENCE = value of LEVEL when the 2/4 LED goes out

LOW REFERENCE (example in Fig. 14) = value of LEVEL when the low fuel LED is on and the ¼ LED goes out.

VALUE FOR EMPTY TANK = value of LEVEL with an empty tank.

These parameters are displayed only if NONSTANDARD or NONSTANDARD INVERTED sensor is selected.

ONLY LOW FUEL SENSOR TYPE

Select this option if a sensor with the exclusive function of indicating low fuel for LPG or NATURAL GAS is used.

Leonardo 175 Setup

ONLY LOW FUEL

TPS TYPE (Fig.16, 17,18)

This indicates to the LEONARDO ECU which type of THROTTLE POSITION SENSOR is read by the BLUE-YELLOW wire.

LINEAR 0-5V – select this option if, when the gas pedal is depressed, the voltage of the TPS signal wire gradually increases from 0.4V with gas pedal at idle to about 4.5V with gas pedal in full throttle position.

LINEAR 5-0V – select this option if, when the gas pedal is depressed, the voltage of the TPS signal wire gradually decreases from 4.5V with gas pedal at idle to about 0.4V with gas pedal in full throttle position.

DIRECT SWITCH – Select this option if, when the gas pedal is slightly depressed, the voltage of the TPS signal wire instantly switches from about 0.5V to about 4.5V or 11.5V (depending on the type of engine).

PLEASE NOTE: the maximum value that is displayed on the hand-held tester is 5V.

INVERTED SWITCH – Select this option if, when the gas pedal is slightly depressed, the voltage of the TPS signal wire instantly switches from about 4.5V or 11.5V (depending on the type of engine) to 0.5V.

PLEASE NOTE: the maximum value that is displayed on the hand-held tester is 5V.

MONOBOSCH – This TPS type has two signal wires whose signals change differently in each wire. Select the **MONOBOSCH** function only if connecting to wire 2 of the TPS connector.

It is advisable, however, to connect to wire 4 of the TPS connector and program the LEONARDO as LINEAR 0-5V.

NO TPS – Select his function **only** if the engine is not provided with TPS.

TPS TYPE

LINEAR 0-5 V

O2 SENSOR TYPE

This indicates to the Leonardo ECU what type of oxygen sensor is present on the vehicle.

Before selecting the oxygen sensor type, it is necessary to check for proper operation of this unit by using a digital multimeter. One of the probes of the multimeter must be put to ground at the negative post of the battery. The other probe must be connected to the oxygen sensor’s signal carrier wire. The following page has information useful for determining the oxygen sensor type.

0 - 1V (Fig. 19)

Select this option if the voltage on the signal carrier wire toggles between the following values:
about 0 - 0.2V with lean mixture
about 0.8 - 1V with rich mixture

Leonardo 175 Setup

0 - 5V type A

This option refers to oxygen sensor types that are presently not available. When these sensor types become available, this manual will be updated with the appropriate instructions.

0 - 5V type B (Fig. 20)

Select this option if the voltage on the signal carrier wire toggles between the following values:
about 0 - 0.2V with lean mixture
about 4.8 - 5V with rich mixture

5 - 0V type A (Fig. 21)

Select this option if the voltage on the signal carrier wire toggles between the following values:
about 4.8 - 5V with lean mixture
about 0 - 0.2V with rich mixture

5 - 0V type B

This option refers to oxygen sensor types that are presently not available. When these sensor types become available, this manual will be updated with the appropriate instructions.

0.8 - 1.6V (Fig. 22)

Select this option if the voltage on the signal carrier wire toggles between the following values:
about 0.7 - 0.8V with lean mixture
about 1.4 - 1.6V with rich mixture

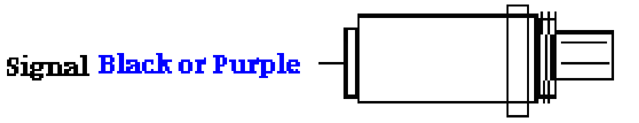
.

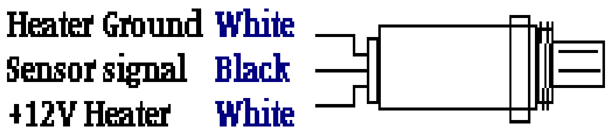
List of Oxygen Sensors

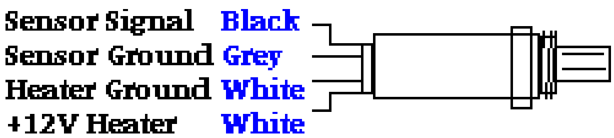
• **0 - 1V OXYGEN SENSORS**

These sensors, while having a variable number of wires,all have the same operation. The voltage on the signalcarrier wire while the sensor is hot toggles between:

- **0 - 0.2V LEAN** mixture
- **0.45V** cold sensor
- **0.8 - 1V RICH** mixture
- **If the voltage remains steady on about 0.45V even when the sensor is supposed to be hot and therefore the voltage should be toggling, it is very likely that the sensor is malfunctioning**







• **RESISTOR TYPE OXYGEN SENSORS**

The FIRST of these sensor types is a 3-wire one and usually carries these colours:

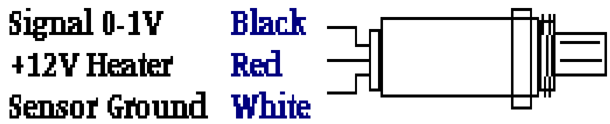
- **RED** heater
- **BLACK** 0 - 1V signal
- **WHITE** sensor ground

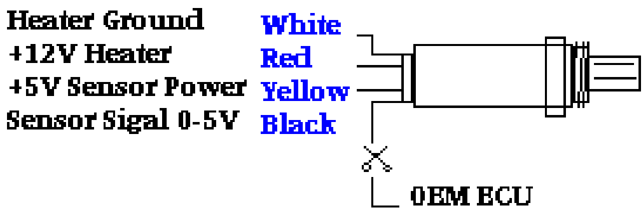
In this case, only the PURPLE wire of the VOILA PLUS mustbe connected, and the GREY wire must be isolated.

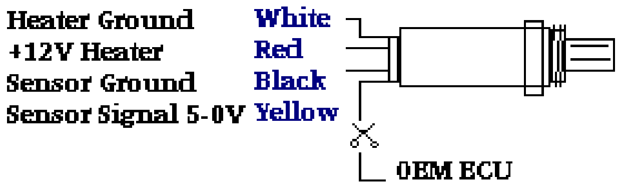
Program the ECU for the 0 - 1V SENSOR.

The SECOND of these sensor types is a 4-wire one and the voltage toggles between 0 - 5V (DIRECT) or 5 - 0V (INVERTED). To establish if the sensor is of the DIRECT or INVERTED type, proceed as follows:

- Cut the signal carrier wire, which is usually black or yellow in colour.
- Turn the ignition key ON.





- By using a digital multimeter, measure the voltage present on the signal carrier wire towards the OEM ECUas indicated in Figs. 2 and 3. • **If the voltage is 0V, select 0 - 5V type B sensor (Fig.2)** • **If the voltage is 5V, select 5 - 0V type A sensor (Fig.3)** **PLEASE NOTE: The functions** **- 0 - 5V type A** **- 5 - 0V type B** refer to oxygen sensor types that presently are not on the market, thus they are not to be considered. **When these sensors become available, this manual will be updated with the appropriate instructions.**	

Leonardo 175 Setup

O2 SENSOR READING DELAY (Fig.23)

• **Normally, the oxygen sensor behaves as follows:**

- When the oxygen sensor is cold, that is, right after the engine has been started, the voltage on the oxygen sensor signal carrier wire is steady at about 0.45V.

- After a few minutes, the oxygen sensor reaches the operating temperature and the voltage on the signal carrier wire begins to toggle between 0.2V (LEAN mixture) and 0.8V (RICH mixture).

Under these conditions, the LEONARDO works correctly.

• **On some of the new vehicles, the oxygen sensor behaves differently:**

- When the oxygen sensor is cold, that is, as soon as the engine has been started, the voltage on the signal carrier wire is kept at a steady 0.8V (RICH carburetion signal) by the OEM ECU.

- After a few minutes, when the oxygen sensor has reached operating temperature, the OEM ECU "unlocks" the oxygen sensor and a voltage toggling between 0.2V (LEAN mixture) and 0.8V (RICH mixture) can be read.

Under these conditions, the LEONARDO ECU does not work properly, because it reads a voltage of 0.8V (RICH carburetion signal) for several minutes during the cold phase. Under this condition, the LEONARDO commands the fuel flow modulating stepper motor to close the flow of the fuel completely; therefore, the engine stops operating.

To eliminate this potential problem, it is sufficient to program the unit to delay the reading of the oxygen sensor (**OXYGEN SENSOR READING DELAY**).

To correctly enter the correct value of the delay, proceed as follows:

- Select **SELECT DISPLAY PARAMETERS (Fig. 24)**

- Start the engine on petrol. Observe that on the tester display the **LAMBDA voltage** is steady at 0.8V

- Count the time elapsed between engine start and the point at which the voltage begins to toggle between 0.8V and 0.2V. This is the value that is to be entered in the **OXYGEN SENSOR READING DELAY (Fig. 25)**. We recommend adding a few seconds to this value. With this programming, the LEONARDO ignores the oxygen sensor signal for the time progammed, and keeps the stepper motor at its DEFAULT value. The LEONARDO becomes operational after the oxygen sensor has been "unlocked" by the OEM ECU.

TYPE OF O2 SENSOR SIMULATION

The LEONARDO fuel management computer includes an oxygen sensor signal simulator, which has the function of
reproducing an oxygen sensor signal pattern that is acceptable to the OEM ECU during the alternative fuel operation.
Normally, the oxygen sensor's signal carrier wire is cut and connected to the PURPLE and GREY wires of the
LEONARDO. The PURPLE wire (connected to the oxygen sensor) is used as an input to control the alternative fuel
carburetion, while the GREY wire (connected to the OEM ECU) delivers a simulated signal to prevent the acquisition
of incorrect data by the OEM ECU which could adversely affect petrol operation.
The type of simulation changes according to the different types of OEM ECU.

Leonardo 175 Setup

STANDARD SQUARE WAVE (Fig.26)

The simulation is a square wave with fixed frequency, i.e.

CONSTRUCTED SQUARE WAVE (Fig. 27)

By using this function, it is possible to generate an oxygen sensor simulation with specific characteristics. When this function is selected, it is possible to modify the following parameters:

HIGH WAVE DURATION (rich carburetion signal) (Fig.28)

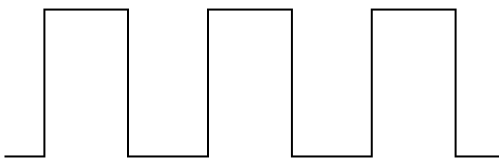
This value, expressed in seconds, determines the duration of A (see Figure below). This parameter is displayed only if the CONSTRUCTED WAVE function is selected.

LOW WAVE DURATION (lean carburetion signal) (Fig.29)

This value, expressed in seconds, determines the duration of B (see Figure below). This parameter is displayed only if the CONSTRUCTED WAVE function is selected.

Fig 26

RICH carburetion



LEAN carburetion

Fig28 High Wave

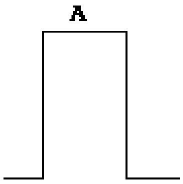
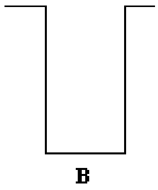


Fig 29 Low Wave



CUIT

GROUND SIMULATION (Fig.33)

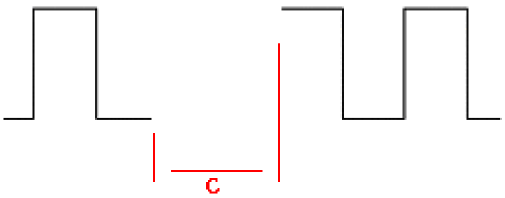
When this type of simulation is selected, during alternative fuel operation the oxygen sensor wire coming from the OEM ECU and connected to the GREY wire of the LEONARDO is kept grounded.

0.72 s

Leonardo 175 Setup

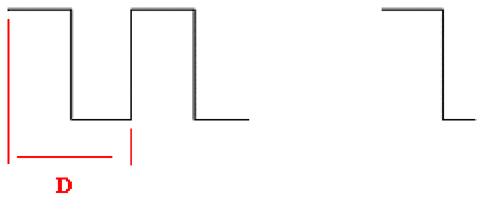
O2 SENSOR OPEN CIRCUIT DURATION (Fig.30)

This value, expressed in seconds, determines the length of the C interval that is the time during which the OEM ECU does not receive any simulated signal. The signal stays polarized by the internal resistor of the OEM ECU. This parameter is displayed only if the CONSTRUCTED WAVE function is selected.



NUMBER OF SIMULATED WAVES (Fig.31)

This value determines the number of waves sent to the OEM ECU before disconnecting the oxygen sensor signal. A wave is defined as the sum of the high and low duration time indicated as **D** in the figure below, which shows two waves being generated before disconnecting the signal.
This parameter is displayed only if a disconnected sensor time different than 0 is entered.



OPENCIRCUIT (Fig.32)
When this type of simulation is selected, during alternative fuel operation the OEM ECU wire that is connected to the GREY wire of the LEONARDO receives no signal, that is, it is an open circuit. The open circuit remains polarized by the internal resistor of the OEM ECU.

YELLOW WIRES UTILIZATION (Fig.34)
The two yellow wires of the LEONARDO ECU are connected to an internal RELAY and they can be used for two different functions. This option allows the selection of either:
DISCONNECT INJECTORS
Enter this option when the two yellow wires are used to open a circuit during the alternative fuel operation, and restore it during petrol operation (ie. fuel injection or indicator lamp).
DISCONNECT (CLEAR) MEMORY (Fig. 35)
Enter this option when the two yellow wires are used to open circuit the memory wire of an OEM ECU.
When this mode is selected, the memory feed of the OEM ECU is open circuited by the two yellow wires a few seconds after the ignition key has been turned off (this is to allow the engagement of possible anti-theft devices). The circuit is restored after a few minutes.

ERASE MEMORY (Fig. 36)
When the OK key is pressed on this function, all previously entered parameters are erased from memory and the LEONARDO is brought back to the original base configuration.
Press the OK key. The display will show the verbiage as in Fig. 37.
Confirm by pressing the OK key once again.
If this function has been selected in error, press the ESC key in order to go back to the main menu without changing any parameter.

SETTINGDESCRIPTION
FUEL SWITCH-OVER TEMPERATURE (Fig.1)
Indicates the temperature that the pressure regulator must reach before the system is automatically switched to alternative fuel mode.
To utilize this option, it is necessary to have a regulator provided with

appropriate temperature sensor.

OVERREV OPTION (Fig.2)

When catalysed fuel injection vehicles reach a predetermined RPM, an electronic governor is engaged which, depending on the vehicle, may act either on ignition or on fuel injection.
The purpose of this governor is to prevent the engine from reaching a dangerously high RPM, thus preventing engine damage.
During alternative fuel operation, the governor is disabled if it achieves governing by using the fuel injectors, while it could cause backfires if it achieves governing by controlling ignition. It is therefore necessary to offer the option that allows an automatic switchover from ALTERNATIVE FUEL to PETROL when approaching the threshold at which the OEM governor is supposed to engage.
In this way, the governing function is preserved because the engine is running on petrol.

OVERREV ENGAGEMENT THRESHOLD (Fig.3)

Indicates the number of engine RPM at which the LEONARDO ECU switches automatically from ALTERNATIVE FUEL to PETROL.
This function is displayed only when the OVERREV option is enabled.

AUTOMATIC SWITCH BACK TO PETROL OPTION (Fig. 4)

By enabling this option, the LEONARDO ECU automatically switches to PETROL when the ALTERNATIVE FUEL LEVEL decreases to a predetermined value.

ALTERNATIVE FUEL LEVEL FOR PETROL SWITCHOVER (Fig. 5)

This number indicates the value of the ALTERNATIVE FUEL LEVEL at which the ECU automatically switches from ALTERNATIVE FUEL to PETROL.

```
FUEL SWITCH-OVER
TEMPERATURE
1 5 ° C
```

Leonardo 175 Setup
OPTIONALCONFIGURATIONS

WARNING: THE FUNCTIONS DESCRIBED IN THIS PAGE MUST BE MODIFIED ONLY WHEN NECESSARY. THE BASE CONFIGURATION IS OPTIMIZED FOR THE MAJORITY OF VEHICLES. CONTACT OUR TECHNICAL SUPPORT DEPARTMENT WHEN ASSISTANCE IS

REQUIRED.

OPTIONAL DEFAULT LOCK (Fig.6)

The locked default option is to be utilized only in particular cases when the vehicle is malfunctioning.

DEFAULT LOCKED VALUE (Fig.7)

This is the number of steps at which the default is locked.
This function is displayed only if the LOCKED DEFAULT OPTION is enabled.

IDLE OPENING STEPS OVER DEFAULT (Fig.8)

This is the maximum number of steps towards opening that the stepper motor can perform in idle mode.
EXAMPLE: If the stepper's idle default value is 100, entering 30 as the number of idle steps over default will permit the stepper motor to open up to 130 steps.

IDLE CLOSING STEPS UNDER DEFAULT (Fig.9)

This is the maximum number of steps towards closing that the stepper motor can perform in idle mode.
EXAMPLE: If the stepper's idle default value is 100, entering 30 as the number of idle steps under default will permit the stepper motor to close down to 70 steps.

OUT-OF-IDLE OPENING STEPS OVER DEFAULT (fig.10)

This is the maximum number of steps towards opening that the stepper motor can perform in out-of-idle mode.
EXAMPLE: If the stepper's out-of-idle default value is 100, entering 30 as the number of out-of-idle steps over default will permit the stepper motor to open up to 130 steps.

OUT-OF-IDLE CLOSING STEPS UNDER DEFAULT (Fig.11)

This is the maximum number of steps towards closing that the stepper motor can perform in out-of-idle mode.
EXAMPLE: If the stepper's out-of-idle default value is 100, entering 30 as the number of out-of-idle steps under default will permit the stepper motor to close down to 70 steps.
If the cut-off or the full throttle option is enabled, the LEONARDO ignores the above limitations during those modes.

FULL THROTTLE OPTION (Fig.12)

By enabling this function, it is possible to set a position that the stepper motor must reach during full throttle operation. This is useful for those engines for which the normal carburetion in this condition can either be too rich or too lean.

PLEASE NOTE: This function is normally disengaged since the basic fuel management strategy of the LEONARDO is able to ensure a correct

operation in the majority of cases.
When the full throttle option is enabled, the following parameters must be specified:

ACTUATOR POSITION DURING FULL THROTTLE (Fig. 13)

This is the position that the stepper motor must reach during full throttle. To correctly establish the value to be entered, the performance of a road test is recommended with the tester connected to the LEONARDO. Establish at what position the stepper motor must be in order to achieve a stoichiometric condition which is indicated when the display bar of the oxygen sensor flashes alternately on RICH and LEAN. After this value has been entered, repeat the road test, and increase/decrease the value if necessary.

FULL THROTTLE TPS (Fig. 14)

This value establishes the TPS threshold that engages the FULL THROTTLE OPTION, that is, the TPS voltage beyond which the LEONARDO brings the stepper motor to the predetermined full throttle position.

CUT-OFF OPTION (Fig.15)

The CUT-OFF OPTION is useful for those engines whose RPM decrease very slowly during deceleration.During cut-off, the LEONARDO behaves as follows: When the gas pedal is released (IDLE TPS), the LEONARDO ECU limits the fuel flow’s cross-section by bringing the stepper motor to a partially closed position. This position can be set by means of the **ACTUATOR CUT-OFF POSITION** function, which comes factory set at 80 steps.
The LEONARDO exits this condition automatically when the engine RPM goes below a certain value (**RPM DISENGAGEMENT CUT-OFF**) which comes factory set at 1,500 RPM. This value is also adjustable to optimize different engines.
If the gas pedal is depressed during the CUT-OFF mode, the stepper motor is brought back to the default position even if the RPM DISENGAGEMENT CUT-OFF threshold has not been reached.
PLEASE NOTE: Before engaging the cut-off function, the LEONARDO ECU must have learned the carburetion parameters.

LOWER RPM CUT-OFF THRESHOLD (Fig.16)

When enabling the cut-off option, it is necessary to enter the RPM threshold below which the function is disabled, thus bringing the LEONARDO back to its normal operation. If the engine is still accelerated when it goes below the RPM at which the cut-off function has been programmed to disengage, it is necessary to further reduce the threshold.
The above function is displayed only when the CUT-OFF option is enabled.
PLEASE NOTE: We remind you that the threshold is factory set at 1,500 RPM.

ACTUATOR POSITION DURING CUT-OFF (Fig.17)

When enabling the CUT-OFF option, it is necessary to set the position to which the stepper motor must go during the CUT-OFF phase. Before changing

this parameter, it is best to read what the default value of the stepper motor is, and enter as ACTUATOR POSITION DURING CUT-OFF a value that is slightly lower, keeping in mind that 0 is where the fuel is totally shut and 240 is where the fuel is totally open. If the engine still does not decelerate, lower the number of steps until it decelerates correctly.
The above function is displayed only when the CUT-OFF option is enabled.
PLEASE NOTE: We remind you that the threshold is factory set at 80 steps.

IDLE TPS HYSTERESIS (Fig.18)

On many new vehicles the idle control is achieved by a small electric motor that acts directly on the throttle. This continuous change in the position of the butterfly causes a change in the output of the TPS that may adversely affect the LEONARDO, which could interpret this variation as an out-of-idle condition.
The idle TPS hysteresis is a voltage which, when summed to the value of the idle voltage, increases total voltage thus making the idle less sensitive to these small variations.

Set - up procedure

After performing all electrical connections of the LEONARDO harness, proceed as follows to set up the system:
1. Connect the LEONARDO ECU to the PROGRAMMING TESTER by means of the appropriate harness.
2. Configure the ECU according to the characteristics of the vehicle and of the input signals (see VEHICLE CONFIGURATION CHAPTER).
3. By using the TESTER PROGRAMMER, select DISPLAY PARAMETERS and start the engine with the fuel switch on PETROL position.
4. Wait until the oxygen sensor is hot and make sure that it works correctly by toggling between either 0V and 1V, or 0V and 5V, depending on the type of oxygen sensor present on the vehicle. Moreover, check for proper operation of the TPS and of the RPM indicator.
If the above procedures are performed with successful results, check the following:
• that the GREY and PURPLE wires have been properly connected and not juxtaposed (see schematic).
• that the GROUND is properly connected and that there are no false contacts.
• that the OXYGEN SENSOR works properly on petrol. Perform this check by using a digital multimeter.
Replace the sensor if damaged.

• that the BLUE-YELLOW and BROWN wires have been properly connected. Moreover, by using the TESTER
PROGRAMMER, make sure that the configuration of the LEONARDO ECU is appropriate for the type of
signal that is read by these two wires.
5. Switch to ALTERNATIVE FUEL; accelerate and decelerate a few times, making sure that the engine is not
stalling.
6. Bring the engine to 3,000-3,500 RPM and wait until the ECU has memorised the default position (the
factory default is 100 steps).
7. Bring the engine back to idle and adjust the idle mixture at the regulator, making sure by using the tester
that the carburetion is correct.
The optimal position of the stepper motor during the ALTERNATIVE FUEL mode should be within 50-60