FuelTech

WB-O₂ DATALOGGER

Installation and Operation Guide

Summary

1 Presentation

FuelTech WB-O2 Datalogger is a very efficient tool used for monitoring and adjusting combustion engines. It is compatible with any type of engines.

This equipment conditions and reads the Bosch LSU 4.2 wideband O2 sensor with speed and precision for a broad range of mixtures, besides storing the engine's most important information, which allows a detailed analysis of its operation status. It features a channel for capturing the engine's RPM signal, as well as other 4 analog channels that can be configured by the user, making a total of 6 channels of storage capacity in its internal memory.

Another important feature is the high-speed USB connection, which allows easy connection to any notebook or computer, eliminating the demand of serial adaptors and facilitating equipment operation, as external feed is not necessary.

FuelTech WB-O2 Datalogger directly presents the mixture value on the screen. The unit also has an isolated analog output, with value proportional to the lambda measured, which is used when the engine has two O2 sensors to be read with a Datalogger. To have the second reading through this analog output from the second Datalogger (or WB-O2 Meter) connect it to an input from the first Datalogger.

The data and graphs analysis software is very intuitive and easy to operate. It is an intelligent tool, and therefore, it facilitates the adjustment of any engine.

The Datalogger can read any type of analog sensor from 0 to 5V, such as:
- Boost Pressure: using FuelTech ECU MAP Output or a FuelTech PS-10B sensor.
- Fuel Pressure: FuelTech's PS-10B sensor is recommended.
- Oil Pressure: FuelTech's PS-10B sensor is recommended.
- Exhaust Pressure: FuelTech's PS-10B sensor is recommended. In this case, it is necessary to isolate the sensor from the heat with a metallic tube longer than 50cm.
- Throttle Position Sensor (TPS): any 0-5V sensor can be calibrated and used.
- Intake Air Temperature: use the MTE-5053 sensor along with FuelTech ECU.
- Engine Temperature: use the MTE-4053 sensor along with FuelTech ECU.
- RPM Signal: reads FuelTech ECU tach output or any other tachometer output. If none of these applies, the signal shall come from the hall effect distribuitor or, as a last resource, from the ignition coil's negative. The last option is the most susceptible to electromagnetic interference from the coil, thus, is the less precise option.

The WB-O2 Datalogger uses FuelTech's Advanced Self-Calibration Software, a technology that makes the lambda readings much more precise, and allows the reader in the O2 sensor to compensate for errors in the readings caused by the aging or fatigue. Moreover, it uses a Bosch processor, which **calibrates automatically** through the sensor connector's original laser calibration resistor, **dismissing the need for calibration** by the user.

Specifications:
- Lambda readings from 0.65 λ to 9.99 λ;
- Analog output 0-5V (0.65 λ to 4.00 λ)*
- Four (4) Sensor Inputs (0-5V) and one (1) RPM Signal Input to store engine information.

* It can be changed to readings from 0.65 λ to 1.30 λ or from 0.65 λ to 9.99 λ using FuelTech Datalogger's software.

Dimensions: 97mm x 50mm 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

All products manufactured by FUELTECH are warranted to be free from defects in material and workmanship for one year following the date of original purchase. Warranty claim must be made by original owner with proof of purchase from authorized reseller. This warranty does not include sensors or other products that FUELTECH carries but did not manufacture. If a product is found defective, such products will, at FUELTECH's option, be replaced or repaired at cost to FUELTECH. All products alleged by Purchaser to be defective must be returned to FUELTECH, postage prepaid, within one year warranty period.

This limited warranty does not cover labor or other costs or expenses incidental to the repair and/or replacement of products or parts. This limited warranty does not apply to any product which has been subject to misuse, mishandling, misapplication, neglect (including but not limited to improper maintenance), accident, improper installation, tampered seal, modification (including but not limited to use of unauthorized parts or attachments), or adjustment or repair performed by anyone other than FUELTECH.

The parties hereto expressly agree that the purchaser's sole and exclusive remedy against FUELTECH shall be for the repair or replacement of the defective product as provided in this limited warranty. This exclusive remedy shall not be deemed to have failed of its essential purpose so long as FUELTECH is willing and able to repair or replace defective goods.

FUELTECH reserves the right to request additional information such as, but not limited to, tune up and log files in order to evaluate a claim.

Seal violation voids warranty and renders loss of access to upgrade releases.

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3 WB-O2 Datalogger Electric Installation

The WB-O2 Datalogger has two connectors, a 10-way and a 6-way. The unit has a pre-set wire for 6 ways, which connects the O2 sensor to the measurement reader through a standard connector.

The 10-way connector is connected to the 12V, to the RPM signal and it also gives access to the Night Mode input. When connecting this cable to the feed 12V, the light on the display dims for better visualization at night. It can be connected to the vehicle's headlights switch or to a separated key.

The sensor inputs must be configured in accordance to the sensors that will be used, such as air and water temperature, oil pressure, fuel, boost pressure, exhaust gas, etc.
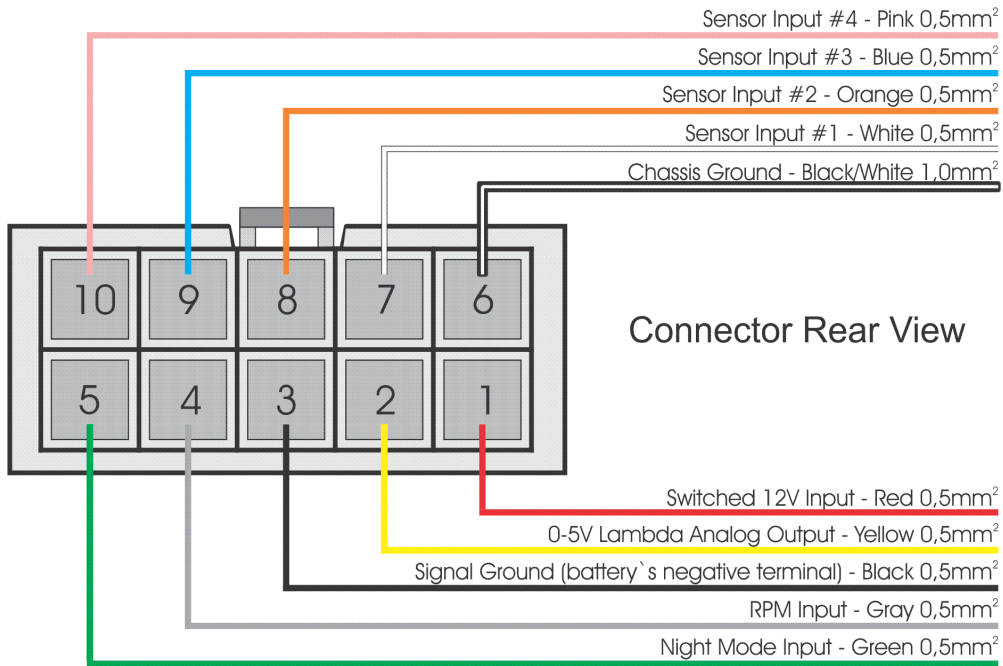
In the case of a V8 engine, when there are two exhaust manifolds, sometimes two O2 sensors are used. It is possible to show the values read by the two sensors on the same Datalogger, and for that, the analog output responsible for the lambda reading must be connected to a sensor input from another Datalogger.

The USB cable that connects the Datalogger to the computer cannot exceed 1,8m, as communication errors and glitches may occur with the use of a longer cable.

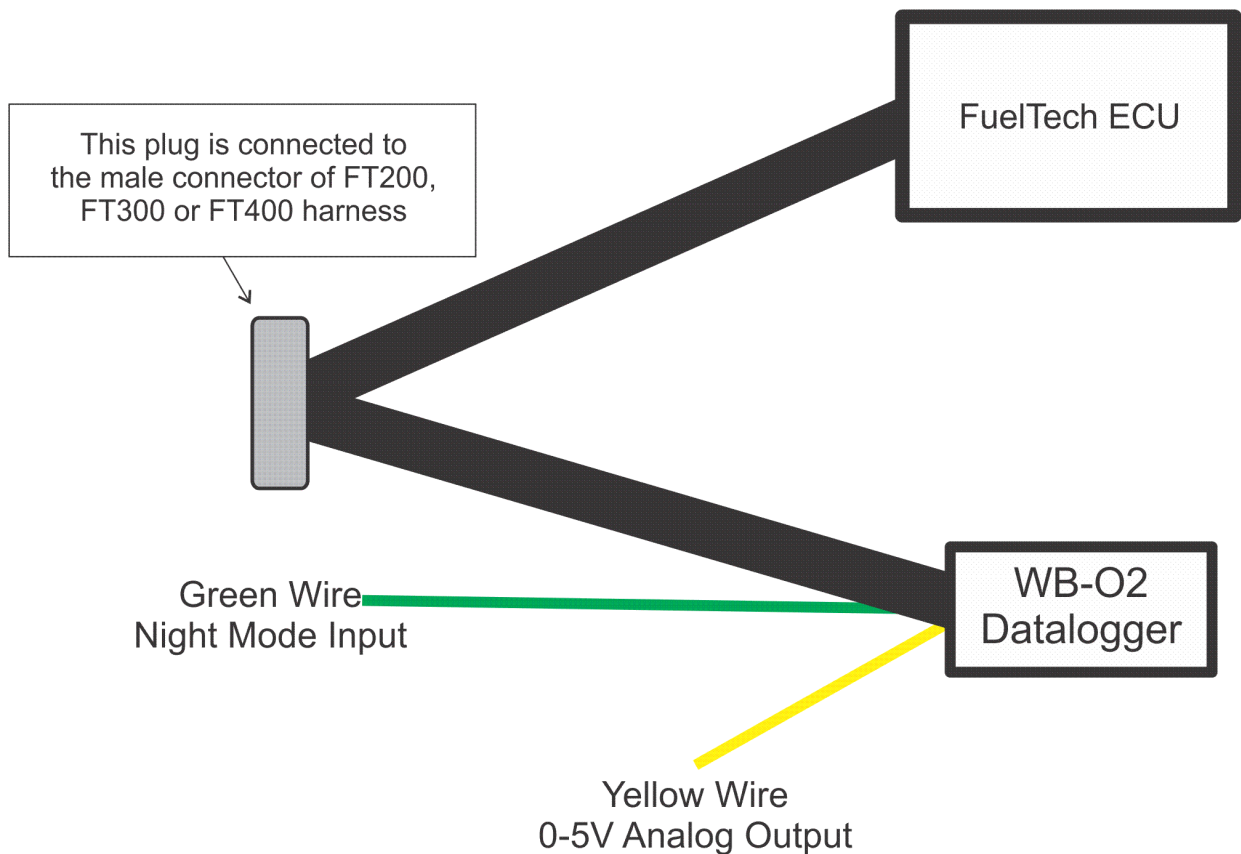Notice the wiring table and diagram below for further details regarding the connections.

Wire Color	Pin	Connection	Note
Red	1	Switched 12V Input	Use a 3A or a 5A fuse.
Yellow	2	0-5V Analog Output	Analog output responsible for the lambda readings. See chapter **Erro! Fonte de referência não encontrada.** in this manual for more information.
Black	3	Battery's Negative Terminal	Must be directly connected to the battery; no add-ons or seams allowed.
Gray	4	RPM Input	Must be connected to FT200, FT300 or FT400 tachometer output, to the Hall effect distributor signal or to the ignition coil's negative terminal (as a last resource, can read interference)
Green	5	Night Mode Input	Connected to the vehicle's headlight switch. It dims the display light when receives +12V.
Black/White	6	Chassis Ground	Power ground, connected to the vehicle's chassis.
White	7	Sensor Input #1	Connected to a sensor with analog signal from 0 to 5V. See chapter 4 in this manual for more information.
Orange	8	Sensor Input #2	
Blue	9	Sensor Input #3	
Pink	10	Sensor Input #4	

3.1 Electrical Wiring Diagram

Sensor Input #4 - Pink 0,5mm^2
Sensor Input #3 - Blue 0,5mm^2
Sensor Input #2 - Orange 0,5mm^2
Sensor Input #1 - White 0,5mm^2
Chassis Ground - Black/White 1,0mm^2

10	9	8	7	6
5	4	3	2	1

Connector Rear View

Switched 12V Input - Red 0,5mm^2
0-5V Lambda Analog Output - Yellow 0,5mm^2
Signal Ground (battery`s negative terminal) - Black 0,5mm^2
RPM Input - Gray 0,5mm^2
Night Mode Input - Green 0,5mm^2

3.2 Datalogger Patch Harness

In order to simplify the installation of the WB-O2 Datalogger, FuelTech sells a patch harness that shares most of the signals with FT such as 12V, negative, ground, oil pressure, fuel pressure, TPS and MAP. The patch harness is a "Y" installed to the male connector of the FT cable, as in the image below:

This plug is connected to the male connector of FT200, FT300 or FT400 harness

FuelTech ECU

WB-O2 Datalogger

Green Wire
Night Mode Input

Yellow Wire
0-5V Analog Output

4 Sensors used with the WB-O2 Datalogger

4.1 FuelTech PS-10B Pressure Sensor

FuelTech PS-10B is a high precision sensor responsible for general pressure readings (fuel, oil, boost, exhaust counter pressure, brake fluid, intake manifold, coolant, boost pressure before the cooler, engine's inner pressure (crankcase), Wastegate valve pressure, etc.).

To use the PS-10 sensor, power it with 12V and connect its signal output to any channel on the WB-O2 Datalogger. Find some information about **FuelTech PS-10 sensor** below:
- Connection: 1/8" NPT
- Pressure Range: 0 to 145psi
- Power Voltage: 8 to 30V
- Accuracy (including nonlinearity, hysteresis, and repeatability): +/- 0.5% at maximum readings range.
- Electric Connector: 3-way AMP Superseal (FuelTech Code 1014)
    Pin 1: Battery's Negative
    Pin 2: Output Signal 1 to 5V
    Pin 3: Switched 12V

Electrical Connections – Sensor View

4.2 Air Temperature Sensor

The sensor that must be used for the measurement of air temperature is the Delphi / NTK ($3.3k\Omega$ at $20°C$) standard.

It is recommended to use a sensor model similar to the ones used by the Fiat lines, which has a metal structure and can be fixed to a nut welded to the intake manifold or at the pressurization.

It must be connected along with a FuelTech ECU to operate properly.

Fiat N° 75.479.76, MTE-5053 ou IG901

4.3 Engine Temperature Sensor

The sensor that must be used for the measurement of engine temperature is the Delphi / NTK ($3.3k\Omega$ at $20°C$) standard.

In cars with air cooling system, this sensor can be placed in the engine oil, as the fluid represents the temperature in which the engine works.

It must be connected along with a FuelTech ECU to operate properly.

4.4 ETM-1 Exhaust Gas Temperature Sensor

Fiat N° 026.906.161.12, MTE-4053 ou IG802

The WB-O2 Datalogger can be used to graphically show the values read from a thermocouple. Therefore, it is necessary to use the FuelTech Thermocouple conditioner ETM-1.

When using a Type K Thermocouple of special construction it is possible to monitor any temperature (spark plug, turbine, exhaust, etc).

The electrical wiring diagram for the FuelTech ETM-1 is as follows:

Pin	Connection	Note
1	Switched Positive (12V)	Must be connected to a switched 12V.
2	Battery's Negative Terminal	Must be connected directly onto the vehicle's battery.
3	Output Signal	Must be connected to one of WB-O2 Datalogger's sensor inputs.
4	Yellow Thermocouple (+)	Thermocouple Positive Signal
5	Red Thermocouple (-)	Thermocouple Negative Signal

4.5 Suspension Travel Sensor

This travel sensor must be installed at the suspension and it informs the movement of the vehicle's body through the Datalogger software. It works as a TPS sensor and it is very useful to improve the tuning of suspension system as a whole. Contact FuelTech for information on how to purchase this sensor.

The electrical wiring diagram of the suspension position sensor is as follows:

Wire Color	Function	Connection
Yellow	Signal output	Must be connected to a sensor input on the WB-O2 Datalogger.
Brown	Battery's Negative Terminal	Must be connected to the battery's negative terminal.
Blue	5V Input	Must be connected to a FT ECU 5V output.

5 Bosch LSU 4.2 Wideband Lambda Sensor

A Wideband lambda sensor is more complex than a conventional one, and it requires a special control unit, such as the FuelTech Wideband O2 Datalogger, which conditions and reads its signals.

Bosch LSU 4.2 sensor has an encased heating element and it is used to measure the proportion of oxygen which determines the lambda value in the remaining exhaust gas. Its signal indications varies from 0.65 lambda (rich mixture) to open air lambda (infinite), and it can also be used as a universal sensor for measuring lambda in all necessary ranges.

The connector includes a calibration resistor (factory calibrated), which defines the characteristics of the sensor and it is necessary for its operation. It is with this resistor that the WB-O2 Datalogger automatically calibrates the sensor.

Bosch Number: 0 258 007 057 –VW Number: 021-906-262-B
Other Bosch LSU 4.2 sensors with the same connector are compatible with this equipment.

Never remove the lambda sensor connector or cut its cables, as any modification in this part completely compromises the precision of the equipments.

Features:
- Continuous response curve
- Lambda measurement range: from 9,56 AFR to infinite
- Quick response: < 100ms
- Resistant to dirt and grime accumulation effects and contamination
- Great resistance to high temperatures
- Resistant to corrosion
- Double protection case

Temperature Range:
- Exhaust gas at the sensor: 850°C
- Sensor encasing hexagon: < 570°C
- Seal joint:
  - By the sensor: < 250°C
  - By the cable: < 200°C
- Cable and wires seal: < 250°C
- Connector: < 120°C

Electronic Data:
- Heating element feed voltage: 9V minimum
- Heating element Power: 10W
- Sensor element: ZrO_2 (Zirconium Dioxide [or Zirconia] – Ceramic)

Bosch LSU Oxygen Sensors are not developed to operate with fuel containing lead, and its life cycle is drastically reduced to an estimated 50 to 500 hours if used in such conditions, depending on how much lead the mixture holds.

Whenever the sensor is installed in the exhaust and the engine is running, the sensor MUST be connected to FuelTech WB-O2 Datalogger, which also needs to be in operation. That is to prevent the equipment from being rapidly damaged from exposure to the exhaust gas without heating control.

6 O2 Sensor Installation

The sensor must be inserted in the exhaust system with its tip exposed to the exhaust gas flow. It must stay in an angle between 10 to 90 degrees to horizontal position, that is, with its end downward, in such a way that steam droplets cannot be accumulated between the body of the sensor and its ceramic part, which could cause damage when the sensor is used. The sensor must not be placed vertically, as it becomes subject to excessive heat.

It is recommended that the sensor stays at least one (1) meter away from the exhaust manifold to avoid excessive heat, and at least one (1) meter away from the exhaust external output to avoid incorrect readings caused by oxygen in the air outside the exhaust system. Notice that such recommendations are not obligatory, as vehicles with a smaller exhaust system will need to have the sensor placed closer to the engine.

The sensor must stay away from the cylinder head and from areas where one cylinder might affect the exhaust air more than the others. Avoid placing the sensor close to the exhaust manifold joints, as some allow the inflow of air, resulting in incorrect readings.

The sensor must never be installed in the exhaust in the 6 o'clock position. The 12 o'clock position is not the most indicated, but can be used. The correct is to install the sensor in the 2, 3, 9 or 10 o'clock positions.
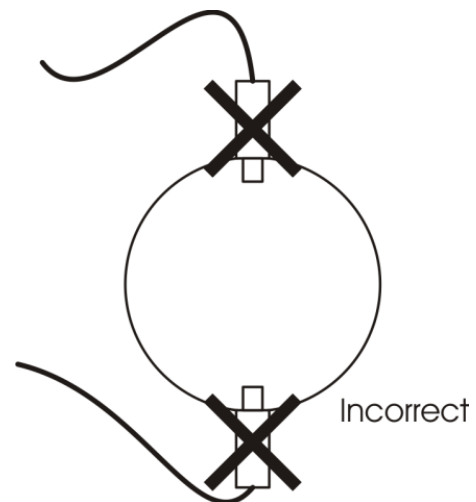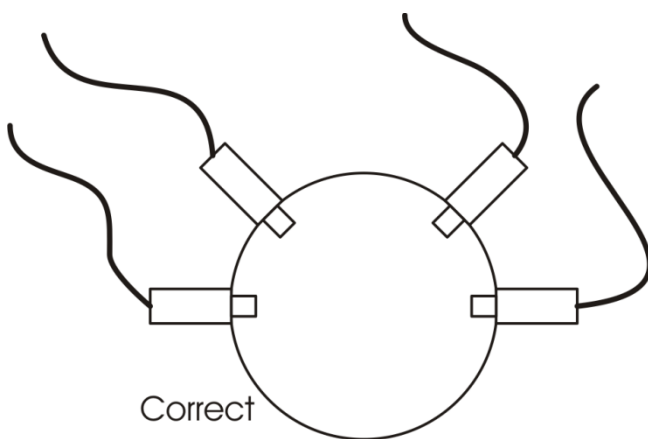
7   WB-O2 Datalogger Codes

Using its display, the WB-O2 Datalogger also transmits to the user some informative and error codes, as specified below.

7.1   Informative Codes

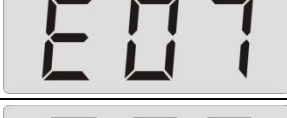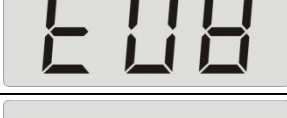| Code	Description
USB	**USB –** This code is displayed on the screen every time the Datalogger is connected to a computer via USB port to transfer data.
REC.	**REC –** This code is displayed when the recording button is pressed. It indicates that the Datalogger is recording all the information read by its inputs. The dot by the letters blinks in a fast pace while the equipment is recording the data.
STO	**STOP –** This code is displayed every time the recording button is pressed to stop recording the data.
FUL.	**FULL –** This code is displayed when the recording internal memory gets completely full. Soon after, the screen goes back to showing the Lambda value, and the dot on the bottom right corner blinks in a slow pace, indicating that the memory is full.
RES	**RESTORING –** This code is displayed when the equipment is restoring corrupted data. Generally, data corruption occurs when the module is turned off while recording data to its internal memory.
FOR	**FORMAT –** This code is displayed when the equipment's internal memory is being formatted (erased). The formatting must be prompted by the user via computer.
LO	**LO –** This code is displayed every time the lambda value is lower than the minimum value set in the equipment, which is 0.59λ. That means the air-fuel ratio in the mixture is too rich.
HI	**HI –** This code is displayed every time the lambda value is higher than the maximum value set in the equipment. That means the air-fuel ratio in the mixture is too lean.
H.E.A.	**HEATING –** This code is displayed when the O2 sensor is being heated by the equipment. The heating process might take up to 60 seconds. The dots by each letter light up in a sequence to indicate that the sensor is reaching the temperature in which it operates.

7.2 Error Codes

Code	Description	Procedure
E01	**E01:** Error 01 – Internal processor error	It is necessary to send the equipment to FuelTech for repair.
E02	**E02:** Error 02 – Sensor disconnected	Check cables and connections or if the sensor is disconnected.
E03	**E03:** Error 03 – Short circuit with the ground on the sensor's heating element or damaged heating element.	Check cables and connections or replace the sensor.
E04	**E04:** Error 04 – Short circuit with the positive on the sensor's heating element or damaged heating element. Lack of power ground.	Check cables and connections or replace the sensor. Check power ground connection.
E05	**E05:** Error 05 – Short circuit with the ground on the signal cables	Check cables and connections or replace the sensor.
E06	**E06:** Error 06 – Short circuit with the positive on the signal cables.	Check cables and connections or replace the sensor.
E07	**E07:** Error 07 – Battery voltage under 10V	Check the battery and the alternator's feed voltage.
E08	**E08:** Error 08 - Internal processor error	It is necessary to send the equipment to FuelTech for repair.
- - -	**- - - :** It indicates that there has been an error condition, and it still exists. The Datalogger functions continue being active.	Turn the equipment off and on to check the error condition again.

8 FuelTech Datalogger Software Installation

Do not connect the WB-O2 Datalogger unit to the computer before concluding all steps for the software installation.

Check FuelTech's website frequently to look for Datalogger software updates.

1. Run FuelTech Datalogger Installation application from the file "SetupDatalogger_xxx.exe", found on the Installation CD, in case it is not executed automatically when the CD is inserted. If your computer does not have the .NET Framework Package installed, the system will show an alert message and will proceed with the installation of such application before continuing the installation of the Datalogger software;

2. Now, you have reached the starting point of the Datalogger software installation. Click on "Find…" to change the location where the software will be installed, or click on "Install" to use the standard directory (C:\Program Files\FuelTech\FuelTech Datalogger);

3. Then, click on "Finish" to end the installation and start the program.

9 Lambda and Stoichiometric Relation Tables

9.1 Lambda and Stoichiometric (AFR) Table

Lambda λ	Gasoline	Ethanol	Methanol	Natural Gas (NGV)	Diesel
Stoichiometric Value	*14,7*	*9*	*6,4*	*17,2*	*14,6*
0,65	9,56	5,85	4,16	11,18	9,49
0,70	10,29	6,30	4,48	12,04	10,22
0,75	11,03	6,75	4,80	12,90	10,95
0,80	11,76	7,20	5,12	13,76	11,68
0,85	12,50	7,65	5,44	14,62	12,41
0,90	13,23	8,10	5,76	15,48	13,14
0,95	13,97	8,55	6,08	16,34	13,87
1,00	14,70	9,00	6,40	17,20	14,60
1,05	15,44	9,45	6,72	18,06	15,33
1,10	16,17	9,90	7,04	18,92	16,06
1,15	16,91	10,35	7,36	19,78	16,79
1,20	17,64	10,80	7,68	20,64	17,52
1,25	18,38	11,25	8,00	21,50	18,25
1,30	19,11	11,70	8,32	22,36	18,98

9.2 Lambda Analog Output in Volts – 8.67 to 16.17 AFR (default)

AFR	Volts (V)
8.67	0.200
16,17	4.800

9.3 Lambda Analog Output in Volts – 9.55 to 19.11 AFR

AFR	Volts (V)
9.55	0.200
19.11	4.800

9.4 Lambda Analog Output in Volts – 9.55 to 58.8 AFR

Lambda λ	Volts (V)
9.55	0.200
58.8	4.800

9.5 Lambda Analog Output in Volts – 9.55 to 146.85 AFR

Lambda λ	Volts (V)
9.55	0.200
146.85	4.800

When there is an output reading error, the analog output locks at 0.00V. Thus, it is possible to know if there is any problem or error in the equipment. To calibrate this output on external equipment, it is suffice to supply the first and last values of the table above.