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+1 413 233 1888

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KT317WB-AFR-12/24

Lean Burn Adapter Kit

1 INTRODUCTION

The GAC KT317WB-AFR Lean Burn Adapter Kit includes the EAM212, a ready to use lean burn adapter for the FIMS500 AFR2XX Series controllers. The EAM down converts a wideband Bosch LSU4.2 signal for use with the AFR with 0 - 1 V DC narrowband input.

The Lambda can be adjusted between 0.5 and 1.5, using GAC's SmartVU engine control software. The performance for the particular Lambda setting is dependent on the load characteristics of the engine. These parameters are also adjusted with SmartVU. The EAM212 is included in this kit KT317WB-AFR.

This kit is intended for use with the AFR210 or AFR211.

To best protect the engine from excessive heat, GAC recommends using a system with EGT (Exhaust Gas Temperature) monitoring. GAC recommends using the STE101 with the AFR210 or AFR211.

The 24 V DC kit also includes the PCI106, a 24 V DC to 12 V DC converter and its related connector kit.

The KT317WB-AFR-12 kit includes:

(1) **EAM212** Lean Burn Adapter

(1) **SOX104** Bosch LSU4.2 Wideband Oxygen Sensor

(1) **CH1523** Sensor Extender Cable

(1) **HW11-025** O2 Sensor Mounting Bung

KT317-4 Programming Cable

EAM204 - RS232 to USB connector available

2 SPECIFICATIONS

POWER	
Operating Voltage	9.8 to 16 V DC, 24 V DC w/ PCI106 Converter
Input Current, O2 Heater Initial Warm-Up	2.0 A Nominal, 3.0 A MAX
Input Current, O2 Normal Operation	0.8 A Nominal, 1.1 A MAX

ENVIRONMENT	
Operating Ambient Temperature	0°F to +140°F [-18°C to +60°C]
Storage Temperature	-40 °F to 185 °F [-40 °C to 85 °C]
Water Resistance	Splash Resistant, Non-Submersible

SENSORS	
Compatible Types	Bosch LSU4.2
Bosch Heater Control	Digital PID via Pump-Cell Impedance

MEASUREMENTS	
Lambda	.61 to Free Air Accurate to ±.007 (.1 AFR)
Air/Fuel Ratio	0.82 to 1.5 (λ) Natural Gas,
O2	0 - 20.9%

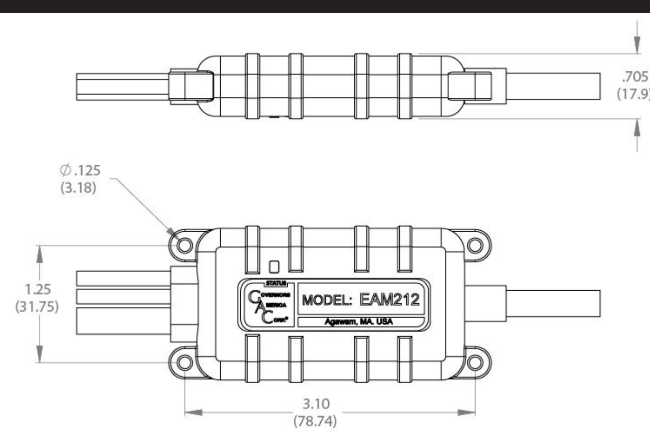
PERFORMANCE	
Free Air to Lambda	< 100 mS (< 25 mS Typical)

3 INSTALLING THE EAM212

The EAM212 controller body should be mounted inside the cabin or in another dry, protected location away from the elements.

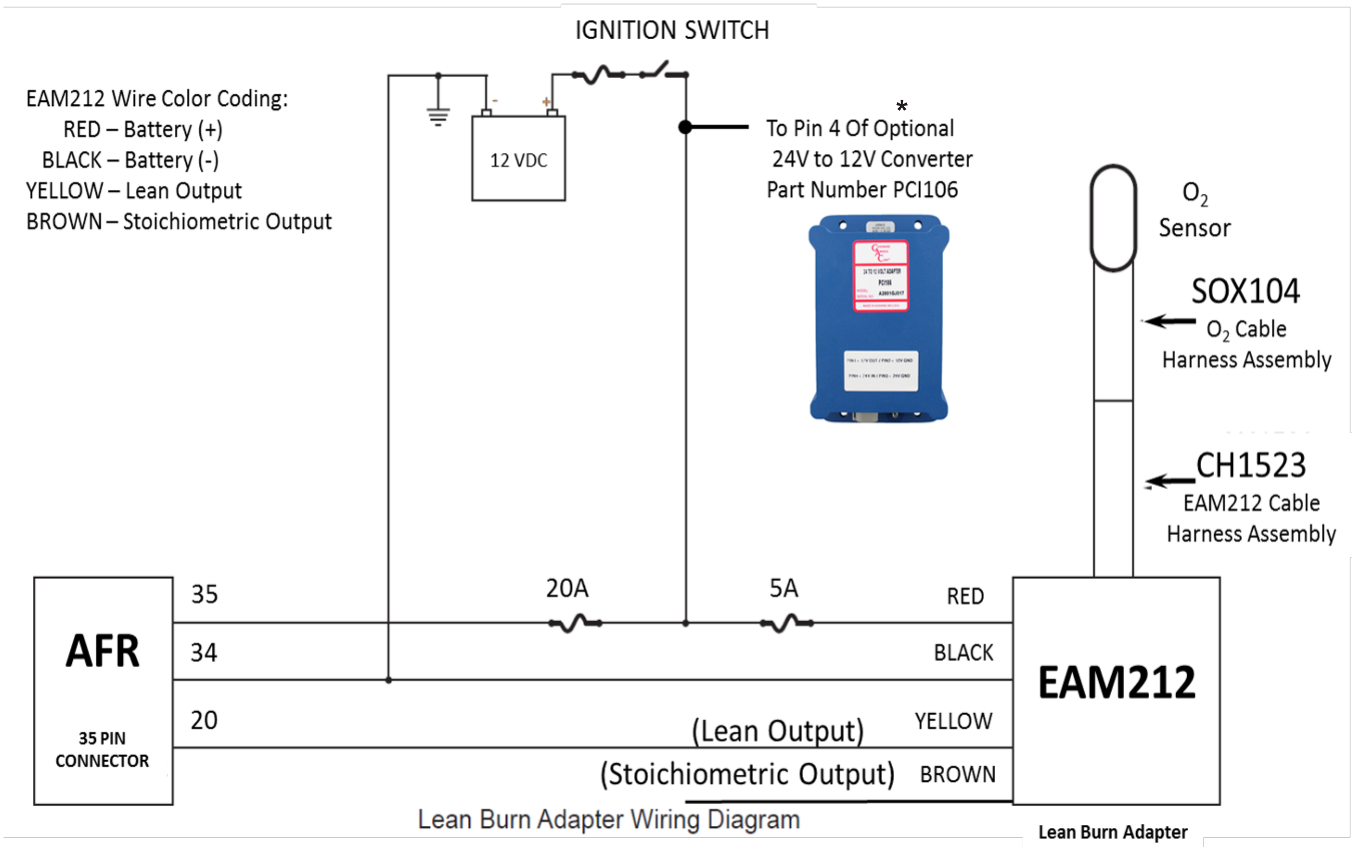
When routing the sensor cable:

- Avoid contact with the exhaust piping and other extreme heat sources that could melt the cable.
- Avoid routing the sensor cable near ignition components or other sources of RF and EMI.



4 WIRING

The EAM212 has 4 striped wires, RED, BLACK, YELLOW, and BROWN.



Lean Burn Adapter Wiring Diagram

* See Section 9 for more details on installing the -24 24 - 12 V converter.

RED WIRE

Connect the RED wire to a switched 12 V source. A switched 12 V source goes ON as soon as key on power is active.

The circuit from which you pull power from should be able to support an additional 3 A draw. Make sure the connection is fused with a minimum fuse size of 5 A.

Circuits that share power with the ignition system, ECU, and fuel pump should not be used. When in doubt, create an additional circuit using an isolation relay. A 24 to 12 V converter, part number PCI106, is included the KT317WB-AFR-24 Lean Burn Kit.

BLACK WIRE

The BLACK wire should be grounded to a solid ground source. The best possible ground source would be the battery ground (-) post. If other devices are going to be daisy-chained along with the EAM212, it is recommended that all devices be connected to a single ground point, ideally the battery ground (-) post.

YELLOW WIRE

The YELLOW wire is connected to the AFR Narrow Band O_2 pre-catalytic converter input.

BROWN WIRE

The BROWN wire is a narrowband simulated output for more precise control.

⚠ **DO NOT connect the brown wire to anything.**

5 OPERATIONAL STATUS LED INDICATORS

LIGHT STATUS	DEFINITION
No Light	No power to the EAM212
GREEN, flashing twice a second	Sensor Warm-up
GREEN, series of quick flashes	Sensor Calibration
GREEN, solid	EAM212 operational, taking readings
RED, series of flashes followed by a pause	The number of flashes indicates an error condition. See the AFR user guide for details on error codes.

6 MOUNTING AND CALIBRATING THE OXYGEN SENSOR

When installed in the exhaust the oxygen sensor MUST be connected and operating with the EAM212 whenever the engine is running. An unpowered oxygen sensor will be quickly damaged when exposed to hot exhaust gases.

⚠ During operation, the oxygen sensor used in this device gets very hot. Do not let a hot sensor touch a combustible surface or use the sensor with or near flammable liquids or gases. Failure to heed these warnings may result in severe burns, explosions or fires.

MOUNTING THE SENSOR

Optimum bung placement will vary from application to application, but using the guideline below will ensure the longest sensor life with the most accurate readings. Using a bung is the preferred method for mounting the oxygen sensor in all applications.

WELDING THE BUNG

Weld the bung at least 24 in [609 mm] downstream of the exhaust port outlet (after the collector), or 24 in [609 mm] after the turbocharger if so equipped. The bung should be welded before the X or H pipe if so equipped. Using the clockface as a reference, mount the bung between the 9:00 o'clock and 3:00 o'clock position.

The bung should always be welded before the catalytic converter. Welding the bung after the catalytic converter will skew the readings toward lean.

⚠ Welding the bung in the lower section of the exhaust pipe can result in sensor damage caused by condensation making contact with the sensor's internal heating element.

SKEWED READINGS

A skew in readings varies with engine load and the efficiency of the catalytic converter. Exhaust leaks, camshaft overlap, and open (shorty) exhausts can cause false lean readings at light engine loads. Typically, once the engine is under load and the exhaust gas volume increases, you will see accurate readings. When fully threaded, the sensor's tip will sit flush with the exhaust pipe; this does not adversely affect the readings.

STARTING THE ENGINE

When installed in the exhaust, the oxygen sensor must be connected to a powered, functional EAM212 (no error codes) whenever the engine is running. An unpowered sensor will be damaged in a short period of time when exposed to exhaust gas.

Do not pre-warm the sensor before starting the engine, simply start the engine as normal. Allowing the sensor to pre-warm before starting the engine will increase the possibility of damaging the sensor from shock-cooling.

The maximum temperature of the sensor at the bung (the sensor mounting location) should not exceed 750 °C [1380 °F].

6 MOUNTING AND CALIBRATING THE OXYGEN SENSOR (CONTINUED)

FREE AIR SENSOR CALIBRATION

Once the EAM212 has been wired and a suitable location found for both the controller and the sensor, perform the sensor calibration. The EAM212 allows you to calibrate the sensor to compensate for sensor wear and atmospheric pressure variances. This procedure takes just a few moments and ensures the most accurate readings throughout the oxygen sensor's life. This procedure is required anytime a NEW oxygen sensor is installed.

NOTE The calibration procedure requires that the oxygen sensor be in free air, this means removed from the exhaust system completely.

POWERING UP

With the sensor disconnected, apply power to the EAM212. When power is applied, the status light will light up green for 2 s while the controller initializes. The status light will then turn red and flash a two blink sequence indicating an Error 2 condition. This error state indicates that no sensor is detected. Leave unit powered on for a minimum of 30 s while it is flashing the Error 2.

CONNECTING THE SENSOR

Power down the EAM212 and attach the oxygen sensor to the sensor cable and the sensor cable to the EAM212. When making these connections, make sure they are fully seated and locked.

CALIBRATION

Power up the EAM212. The status light will light green for 2 s while the system initializes. The status light will flash green twice a second indicating that the sensor is heating up to its operating temperature. After 30 - 60 seconds, the status light will flash green for a series of very quick flashes indicating the sensor calibration is being performed.

When the status light lights solid green this indicates the unit is operational and ready to read the O_2 content in the exhaust gas.

NOTE You may need to disconnect the sensor from the sensor cable to thread the sensor into the exhaust. To do this without losing your calibration, make sure the unit remains powered off while the sensor is disconnected. If you power up the EAM212 without a sensor connected, your calibration will be lost and require the calibration steps be repeated.

7 INSTALLING SMARTVU SOFTWARE

The Lean Burn Adapter requires the latest version of SmartVU. If SmartVU has been previously installed on the computer being used, the previous version must be uninstalled using Windows Control Panel. This document only address the implementation for the EAM212 Lean Burn Adapter. If you are unfamiliar with SmartVU, please take time to review the AFR section of the SmartVU User Guide available on the GAC website.

SmartVU is available as a download from the GAC website (www.governors-america.com). If not already installed, contact your GAC representative for more information.

To install, unzip the downloaded package to a directory and execute SmartVUECsetup.exe. Once executed, the installer will guide you through the remainder of the process.

8 SETTING LAMBDA VALUE USING SMARTVU

MAPPING THE EAM212

Map the output voltage of the EAM212 in the SmartVU O-Tune table of the AFR. The entries in the table represent the number of millivolts for the AFR to adjust to, for a given load at a given speed. This voltage directly translates into a Lambda value as determined by using the Lambda/AFR Translation tables (below). After the O-Tune values have been set, re-adjust the S-Tune performance in SmartVU as was done when the unit ran with a narrowband sensor.

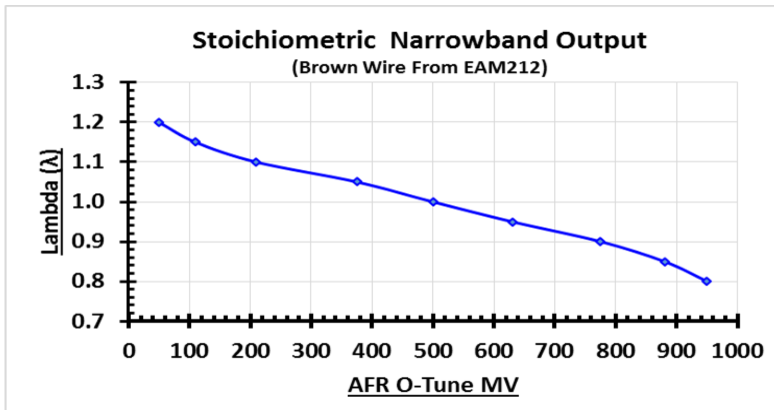
TABLE 1

LEAN BURN OUTPUT

Conversion Table Wideband (Default) Output, Natural Gas			
Lambda (λ)	Voltage	AFR O-Tune Value (mV)	
0.82	0.65	650	RICH
0.84	0.63	625	
0.86	0.60	600	
0.88	0.58	575	
0.91	0.55	550	
0.95	0.53	525	
1.00	0.50	500	STOICH
1.05	0.40	400	
1.08	0.35	350	
1.13	0.30	300	
1.18	0.25	250	
1.22	0.20	200	
1.27	0.15	150	
1.36	0.11	105	
1.50	0.05	45	LEAN

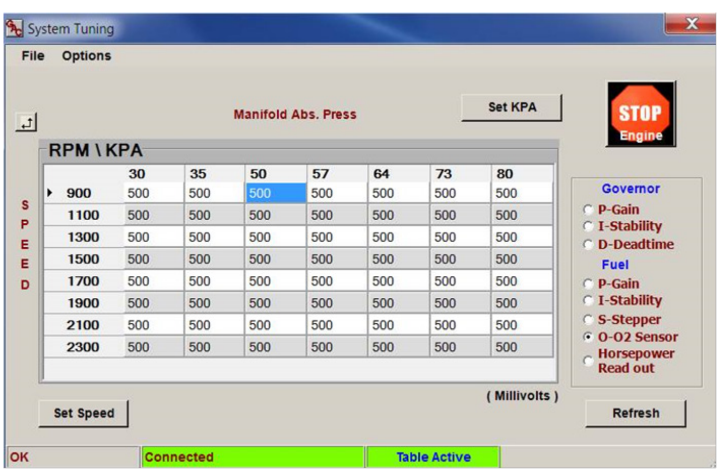
TABLE 2

Conversion Table Stoichiometric / Narrowband Output, Natural Gas			
Lambda (λ)	Voltage	AFR O-Tune Value (mV)	
0.80	0.95	950	RICH
0.85	0.88	880	
0.90	0.78	775	
0.95	0.63	630	STOICH
1.00	0.50	500	
1.05	0.38	375	
1.10	0.21	210	
1.15	0.11	110	
1.20	0.50	20	LEAN



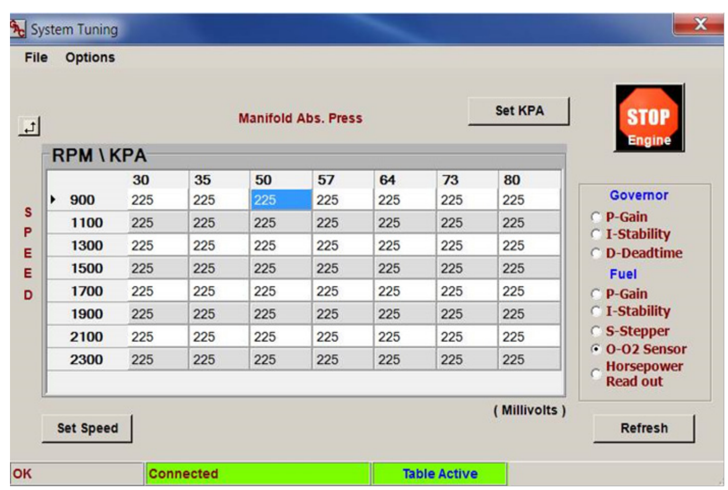
EXAMPLE 1: DEFAULT VALUE STOICHIOMETRIC (BROWN WIRE)

In the example below, notice all the cells are set to 500. Looking at the table, 500 mV translates to a Lambda of 1.0. In this case the AFR will always adjust the air fuel ratio to be stoichiometric.



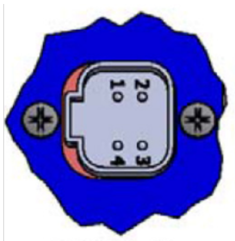
EXAMPLE 2: LEAN BURN (YELLOW WIRE)

This example is running lean burn. The O-Tune values are set to 225 mV. Using the Conversion Table, this represents close to 1.20 Lambda which is Lean Burn.

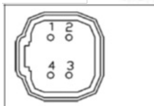


9 24 TO 12 VOLT CONVERTER INSTALLATION

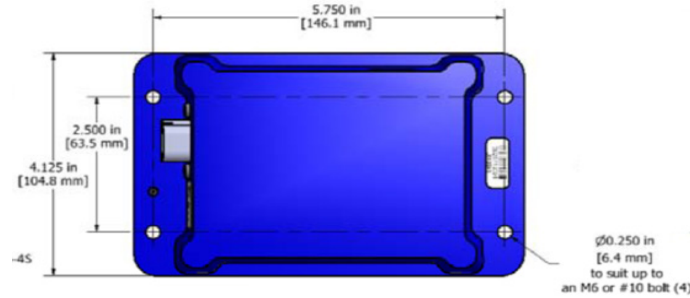
For a 24 V DC supply install a 24 to 12 voltage converter. This unit, PN PCI106, and connector assembly, PN EC1533, are included in the -24 kit.

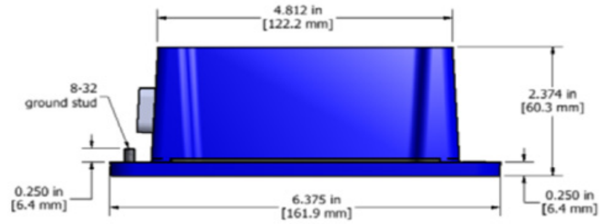


DETAIL A
DT15-4P receptacle
mates with DT06-4S



Deutsch IPD P/N: DT15-4P
1. Output +
2. Output –
3. Power –
4. Power +





Note the following when installing the converter:

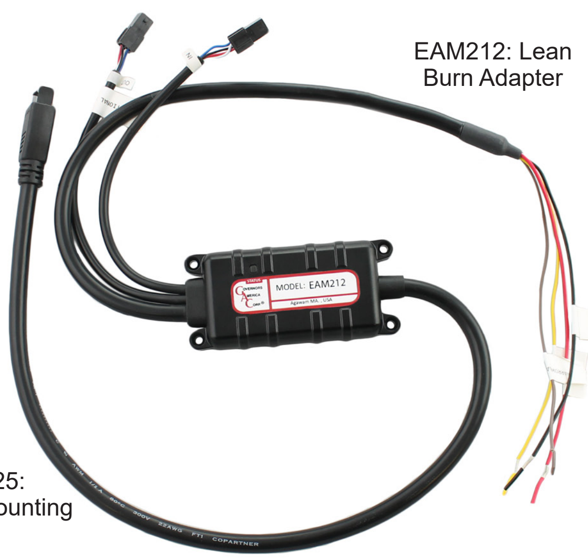
- Pins and connectors are provided to create the wiring harness. The Deutsch crimp tool PT- 48 - 00 or similar is required.
- The harness should be no more than 6.5 ft [2 m] of #16.
- Ensure the unit is properly grounded.
- Mount using M5 or better bolts, and vertically if able, to reduce moisture entry.

KT317WB-AFR-24 LEAN BURN KIT CONTENTS

PCI106: 24 V to 12 V Converter

EC1533: Connector Kit Included with PCI106

EAM212: Lean Burn Adapter



KT317-4: Programming Cable

HW11-025: O_2 Sensor Mounting Bung

CH1523: Sensor Extension Cable

SOX104: Bosch LSU4.2 O_2 Sensor