



***AFA-4 - Multi Channel
Wide Range Air-Fuel Meter***

**COMPETITION DATA SYSTEMS, INC
8050 WEHRLE DRIVE
WILLIAMSVILLE, NY, USA 14221
Voice: (716) 631-2880
Fax: (716) 631-9930**

On the web at www.competitiondata.com

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1. INTRODUCTION

Thank you for purchasing the CDS AFA-4 wide range air fuel ratio meter. This product offers superior price/performance ratio compared to all other true wide band meters on the market.

PLEASE take the time to familiarize yourself with these instructions as most questions and problems you might encounter are addressed here.

LIMITED WARRANTY TERMS

The AFA-4, which is warranted by Competition Data Systems, carries a 1 year limited warranty against defects in material and workmanship. Sensors are warranted for 30 days when used in unleaded fuel. Sensors carry no warranty when used with LEADED fuel.

THIS WARRANTY DOES NOT COVER DAMAGE DUE TO MISUSE, NEGLIGENCE, OR FAILURE TO OPERATE PER DIRECTIONS. THE CUSTOMER'S SOLE REMEDY IS REPAIR OR REPLACEMENT OF THE DEFECTIVE PRODUCT. Corrosion damage due to water or other corrosive agents is specifically excluded from coverage.

This warranty is made to the original purchaser only and is not transferable. Except as provided here, Competition Data Systems, Inc. makes no expressed OR implied warranties, and any implied warranty as to merchantability or fitness for a particular purpose is limited in duration to the duration of the written warranty provided here.

Sensors are warranted for 30 days when used in unleaded fuel, and carry no warranty when used in leaded fuel.

2. INSTALLATION

AFA-4 CONTROL BOX

Choose a location such that the AFA-4 will not be exposed to excessive vibration, water, or excessive heat. Locate the AFA-4 so that you can easily see the front panel.

TIP: Obviously, you need to locate the AFA-4 so that the sensor cables will reach the point in the exhaust system where you intend to install the sensor.

SENSORS

Choose a location in the exhaust system as close as practical to the engine. Drill a hole in the exhaust header (or collector) and weld in the supplied bushing. The ideal operating temperature range for the sensor is 600 to 800 degrees C (about 1100 to 1500 degrees F). The closer the exhaust temperature is to this range, the less the heater will have to work. After you install each sensor, plug its connector into the back of the AFA-4.

TIP: If you are temporarily installing the AFA-4 on a production car which has a lambda sensor, you can remove the stock sensor and install the AFA-4 sensor in the same hole.

TIP: If you are installing the sensor in a collector of a header, make sure it is **upstream** of any slip joints which might have air leaks. Any air leaks (even very small leaks) into the exhaust system will cause a false lean indication on the AFA-4. Also, make sure header bolts are tight and header gaskets are in good condition (no leaks).

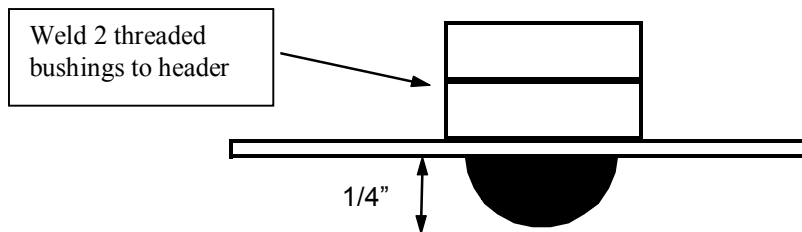
TIP: On production cars with all welded exhaust systems, you can simply slide the sensor up the tailpipe about 2 feet or so. If you do this, be careful to insulate the sensor wire or it may melt if the tailpipe gets real hot. This method works ok for wide open throttle testing, but will usually give false lean readings at low throttle settings due to air getting back in the tailpipe.

Special Considerations for use with Methanol

Due to the low exhaust temperature of methanol powered engines, it is important not to expose the entire “nose” of the sensor to the exhaust gas stream. The sensor “samples” the exhaust gas through the small hole in the very tip.

Locate the sensor in the hottest part of the exhaust when using it with methanol. (this is usually closest to the engine)

AFA-4 units sold for use with methanol include 2 weld bushings for each sensor supplied. Weld both bushings to your header, one on top of the other. This should result in only 1/4” or so of the sensor tip sticking into the exhaust gas stream.



POWER SUPPLY & CONNECTION

2 power supply connections must be made to use the AFA-4, a 12 volt connection using the supplied power cable, and a 5 volt connection through the data output cable (see next section).

The user must supply a battery or power supply to power the AFA-4. The battery or power supply must be capable of supplying at least 2 amps at no less than 12.0 volts. If the voltage drops below 12 volts, the heater in the AFA-4 will not be able to maintain the proper operating temperature of the sensor and the AFA-4 may take a long time to warm up.

Connect the RED wire (with fuse holder) to positive, connect the BLACK wire to negative.

TIP: Voltages greater than 12 volts will reduce the required time for warm-up and help the AFA-4 maintain a steady temperature in the sensor.

VERY IMPORTANT NOTE: The power supply ground (negative) for the AFA-4 Power cable must be at approximately the same voltage as the sensor bodies. THEREFORE, if you are powering the AFA-4 from a battery or power supply **which is NOT grounded to the engine**, you **MUST** run a ground wire from the negative of the battery or power supply to the engine. FAILURE TO COMPLY WITH THIS INSTALLATION REQUIREMENT WILL CAUSE NON-WARRANTY DAMAGE TO THE AFA-4 CONTROLLER.

CONNECTION TO DATA ACQUISITION SYSTEM

Connect the Data Cable from the data acquisition system to the 9 pin port on the front panel. See Section 7 for details of wiring connections if you are making your own interface cable.

There are a total of 6 connections to be made on this cable (assuming you are using all 4 channels of the AFA-4). They are: 4 signal output connections, REGULATED 5.00 volt connection, and data acquisition system ground.

Since the signal outputs on the AFA-4 are optically isolated from the rest of the AFA-4 controller (for accuracy reasons) it is necessary for the data acquisition system to supply a regulated 5 volts to the AFA-4 for the purpose of operating the signal outputs. Current consumption on this 5 volt line is minimal (about 20 milliamps).

IMPORTANT NOTE: The outputs of the AFA-4 are *RATIOMETRIC* to the 5.00 volt reference that you feed to it (on pin 5 of the 9 pin output connector). If you feed it a voltage other than 5.00 volts (such as 5.1 volts), then the outputs will change proportionally, and you must scale the calibration points (given below) appropriately. If you are connecting the AFA-4 to a CDS Commander II, this is not a concern since the Commander II supplies a tightly regulated 5.00 volts.

Calibration Points

Since the output of the AFA-4 is linear with respect to Air-Fuel Ratio, you only need 2 calibration points, which are:

AFA-4 when used with GASOLINE	
VOLTS	AIR/FUEL RATIO
.250	10.5:1
4.75	18.0:1

AFA-4 when used with Methanol (Controller serial number 4100 and higher)	
VOLTS	AIR/FUEL RATIO
.250	4.55:1
4.75	7.85:1

3. OPERATION

STARTUP & CHECKOUT

Switch the power on. The RED LED will light up. Each of the GREEN LEDs will begin to flash slowly at a rate of about 1 time per second. This is WARM-UP MODE. OUTPUT during warm-up mode is dead lean (about 18:1)

After a short time the sensor will heat up and the GREEN LED for each active channel will be lighted constantly.

TIP: If your power supply voltage is marginal, then warm-up may take a long time. Start the engine and the heat from the exhaust will help in heating the sensor up.

Start the engine and observe the outputs using your data acquisition system.

TIP: If you are using a COMMANDER II system, click on the VIEW LIVE READINGS button on the ADVANCED TAB of COMMAND LINK 2000.

AUTO SLEEP (ENGINE OFF) MODE

The AFA-4 has a unique feature called AUTO SLEEP. Basically, when the AFA controller detects that the engine has been off for more than 30 seconds, the controller automatically switches power to each sensor “off”. The controller continues to monitor the output of the sensor and will resume sensor heater operation shortly after you re-fire the engine.

When in AUTO SLEEP mode, each of the GREEN LEDs will “double flash” (blink twice, pause, blink twice, etc).

SENSOR FAULT DETECTION

If a short is detected on a sensor, the GREEN LED for that channel will blink fast, at a rate of about 2 times per second.

4. SENSOR CALIBRATION CHECK

A simple yet effective way to check sensor calibration is as follows. To do this, you will need a nitrogen cylinder.

1. Remove the sensor from the exhaust system
2. Turn the AFA-4 on and wait for the sensor to warm up.
3. Direct a very slight flow of Nitrogen into the hole in the very tip of the sensor.
4. The output should correspond to a reading of between 14.7 and 14.9
5. If the sensor does not respond or reads outside this range, it probably needs to be replaced.
6. If the reading does not settle to a constant value in about 2 seconds or so, the sensor is probably bad.

CAUTION: The sensor will get quite HOT! Handle it by the wires only!

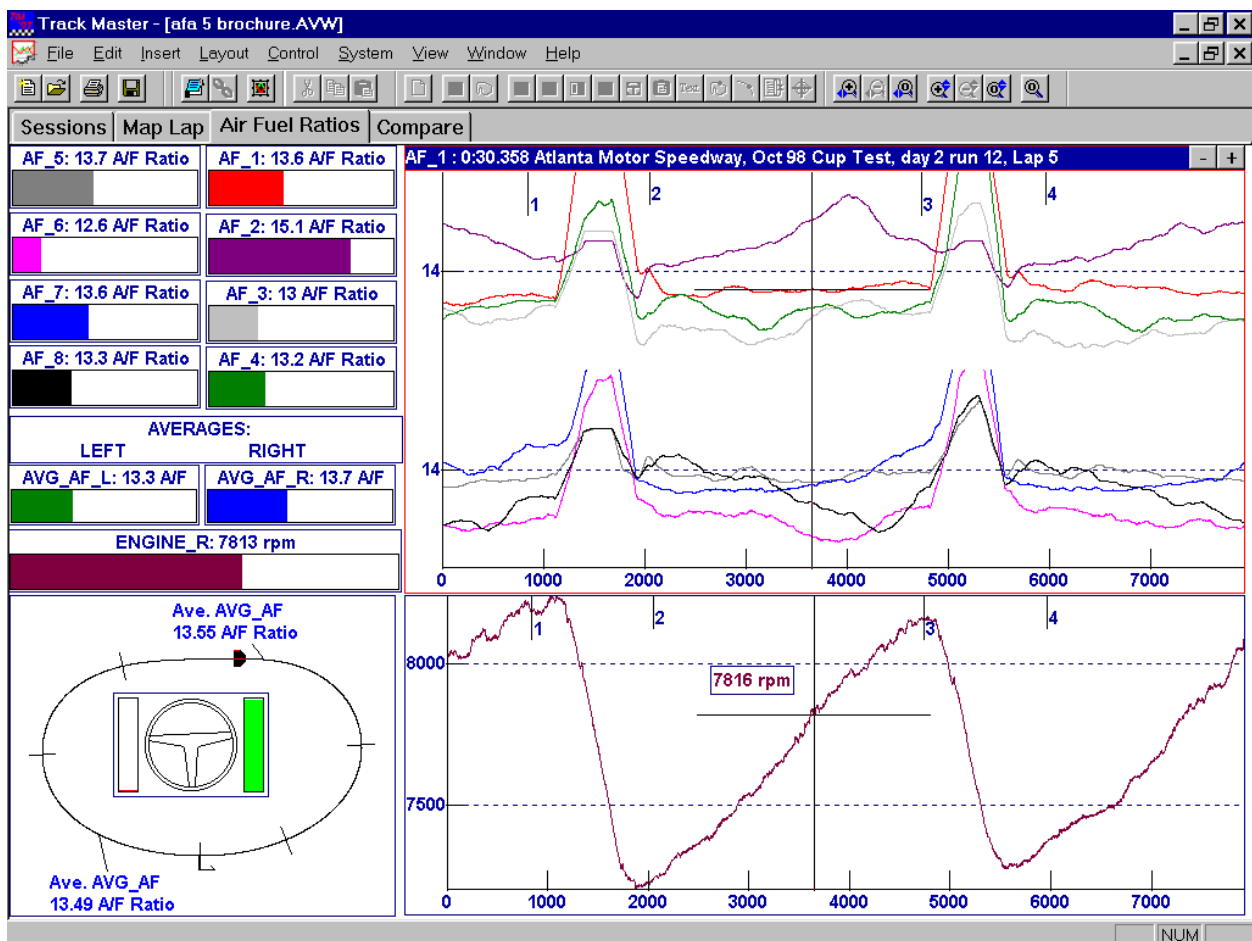
5. DATA INTERPRETATION

Most gasoline powered engines produce best power on the RICH side of Stoichiometric. Since Stoichiometric is about 14.7:1 for gasoline, you should be looking for numbers less than that if you are looking for maximum power.

The analog output updates very quickly and may require some smoothing in your data analysis software, depending on the sample rate used to record it. We recommend a sample rate between 10 and 50 times per second for sampling the AFA-4 outputs.

If you are using a CDS Commander II® system and Track Master 2000® software, we recommend using a sample rate of 50 times per second, and “medium” smoothing.

The following graphs show a typical output of the AFA-4, recording all 8 cylinders of A/F information in and on track Winston Cup test, as recorded by a CDS Commander II system . Notice that the air fuel ratio of each cylinder varies considerable over the course of a full lap and goes extremely lean in the corners when the driver is off the throttle.



6. SPECIFICATIONS

OUTPUT RESOLUTION .01 A/F Ratio

ACCURACY Better than 2% of reading

REPEATABILITY Better than 1% of reading

RESPONSE TIME .02 seconds

SIZE 5½" x 6" x 1.15"

POWER REQUIRED 12 to 18 Volts, @ 8a max NOTE: 12 Volts is MINIMUM!

ANALOG OUTPUT .25 volts = 10.5:1 A/F 4.75 volts = 18:1 A/F

SENSOR LIFE: 500 Hours in Unleaded Fuel, (Life is reduced in leaded fuel and is dependent upon amount of lead in fuel)

7. WIRING PINOUTS

DATA OUTPUT CABLE CONNECTIONS

DB9-M

Pin Number	Description
1	Output Reference (Data system ground)
6	Output #1
7	Output #2
8	Output #3
5	REGULATED +5.00 Volt Input (20 milliamps typical)
9	Output #4

POWER CONNECTOR WIRING

FEMALE CONNECTOR (SOCKETS)

Wire Color	Description
WHITE	Shield
RED	+12v
BLACK	Gnd.

SENSOR CONNECTOR WIRING

MALE CONNECTOR (PINS)

Wire Color	Description
GRAY	Sensor Gnd.
BLACK	Signal
WHITE	Heater
WHITE	Heater