

Figure 1

**Here is a special preview of the new Nightrider.com® Advanced AFR Gauge.** This is the most sophisticated and flexible Narrow Band O<sub>2</sub> AFR monitor available. This fuel mixture gauge can be used by Riders with AFXIED or other tuning products to expand engine monitoring capabilities. It can be used on ANY VEHICLE including motorcycles, ATV or automobiles with one or two narrow band O<sub>2</sub> sensors.

Unlike generic NBO<sub>2</sub> gauges on the market just showing voltage based light display, the Advanced AFR Gauge has specific calibrations for heated (4-wire) and non-heated sensors (1 and 2-wire). You get the most accurate AFR Gauge Display possible using Nightrider.com® advanced micro-controller based design. With one gauge you can monitor single or dual sensors on your bike. There are Modes that allows you to monitor the raw voltages from the O<sub>2</sub> sensors, the average mixture of both cylinders and recent history of individual cylinders. You have a total of ten distinct operating Modes. Using the Nightrider.com® modular connector design allows plug-n-play installation on many motorcycles with the ability to easily move the AFR Gauge between vehicles. Universal installation on motorcycles, ATV's, automobiles and any engine with an NBO<sub>2</sub> is very simple.

At 1.75" x 3.00" x 1.00", it is one of the smallest multi-function NBO<sub>2</sub> AFR gauges on the market. The small size allows for a lot of flexibility in mounting your AFR Gauge.

## COMING MARCH 2016

There are ten operating modes for the new AFR Gauge. Each Mode can be selected by using the rotary selection switch.

- ▶ Average AFR for both 4-wire sensors
- ▶ AFR for cylinder 1 4-wire sensor
- ▶ AFR for cylinder 2 4-wire sensor
- ▶ Average AFR for both 2-wire sensors
- ▶ AFR for cylinder 1 2-wire sensor
- ▶ AFR for cylinder 2 2-wire sensor
- ▶ Average volts for both cylinders
- ▶ Volts for cylinder 1
- ▶ Volts for cylinder 2
- ▶ History of last 20 seconds on both cylinders

Other Features:

- 8 AFR/Voltage LED (Red,Yel,Yel,Grn,Grn,Grn,Grn,Red)
- 3 Status LED (Cyl 1,Cyl 2,2-wire active) indicating all 10 active modes
- Power On LED

The picture of the AFR Gauge (Figure 1) has not been mounted in its weather resistant packing for this document. More photos will be posted when production units are available.

Like our AF-XIED product line, the AFR Gauge will be mounted in epoxy, making it highly water resistant. The rotary Mode switch is rated for 240 hours of full immersion in water. Riders will have a variety of installation methods available. From the standard Universal Installation kit to complete plug-n-play Harness Adapter kits. Simplicity is the key word in the installation. Most installations will never require cutting of any wiring. All wiring will be long enough to allow the AFR Gauge to be mounted on the handle bar. The standard mounting method is with industrial Velcro. Mounting kits will be available for 1" or 3/4" handle bars.

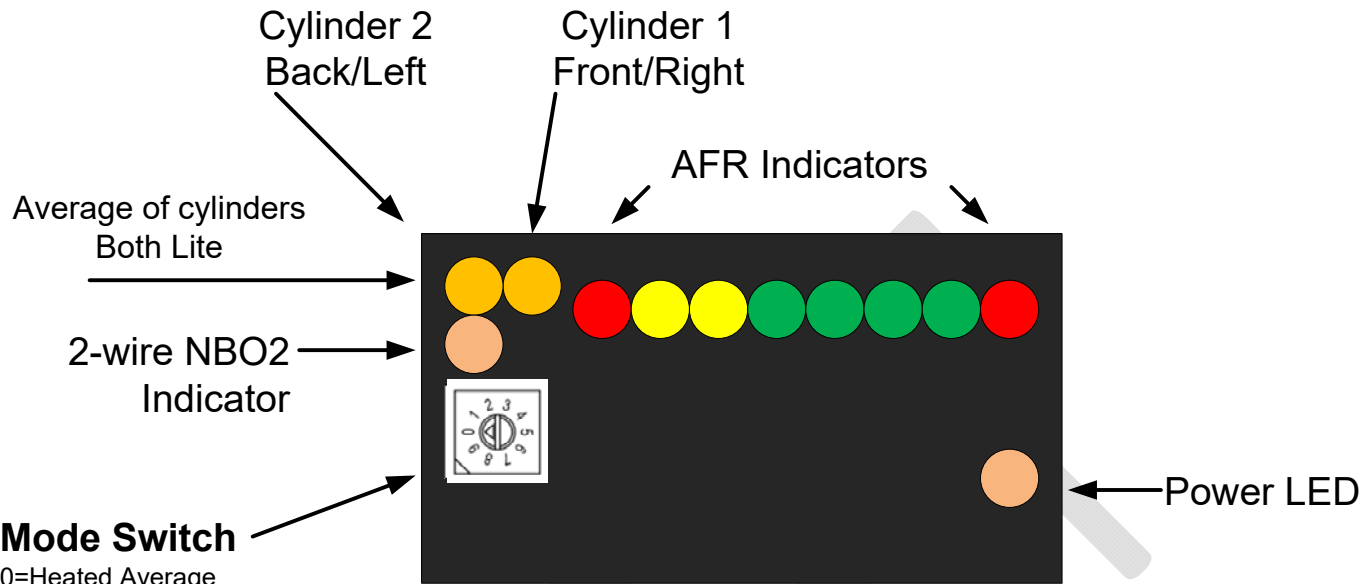
This AFR meter can be used to monitor any Narrow Band O2 sensor. The AFR Meter only requires connections to the O2 sensor signal, ground and a +12v source. The Nightrider AFR Gauge is designed using microcontroller technology for more accurate interpretation and display of fuel mixture readings from your narrow band O2 sensor.

*Compare the Nightrider Advanced AFR Gauge costing \$100 to another motorcycle specific Single O2 Display gauge costing \$249. The same company sells a Dual O2 Display gauge costing \$295. The Nightrider dual NBO2 sensor gauge is less expensive than the competitors single gauge. The Nightrider AFR Gauge has functionality beyond a simple display, allowing a view of voltage from the O2 sensors and stores a history of the last 20 seconds that can be replayed.*

Our gauge is not 'blinged out' with chrome or polished aluminum. It does provide you with functional information on your engine's fuel mixture to improve tuning or give you piece of mind..

Kit Comes with Advanced AFR Gauge, Standard 3 foot Universal Harness, plug-n-play adapter to Vehicle Specific Adapters  
NBO2 Sensors Not Included – Vehicle specific Plug-n-Play Harness Not Included - Handlebar Mount Not Included

## AFR Gauge LED and Switch Layout



### Mode Switch

- 0=Heated Average
- 1=Heated Cyl 1
- 2=Heated Cyl 2
- 3=2-wire Average
- 4=2-wire Cyl 1
- 5=2-wire Cyl 2
- 6=Voltmeter Average
- 7=Volts Cyl 1
- 8=Volts Cyl 2
- 9=History Last 20 seconds

### AFR Range

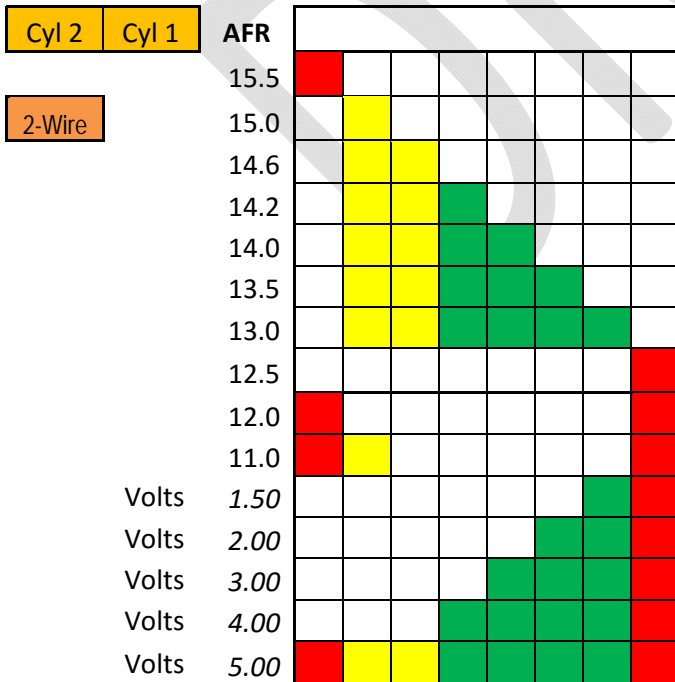
16.0:1 > 10.0:1

Volts

0.1 > 1.2V in .1 Step

1.0 > 5.0 in 1.0 Step

Figure 2



### AFR LED Display shows maximum information at a glance

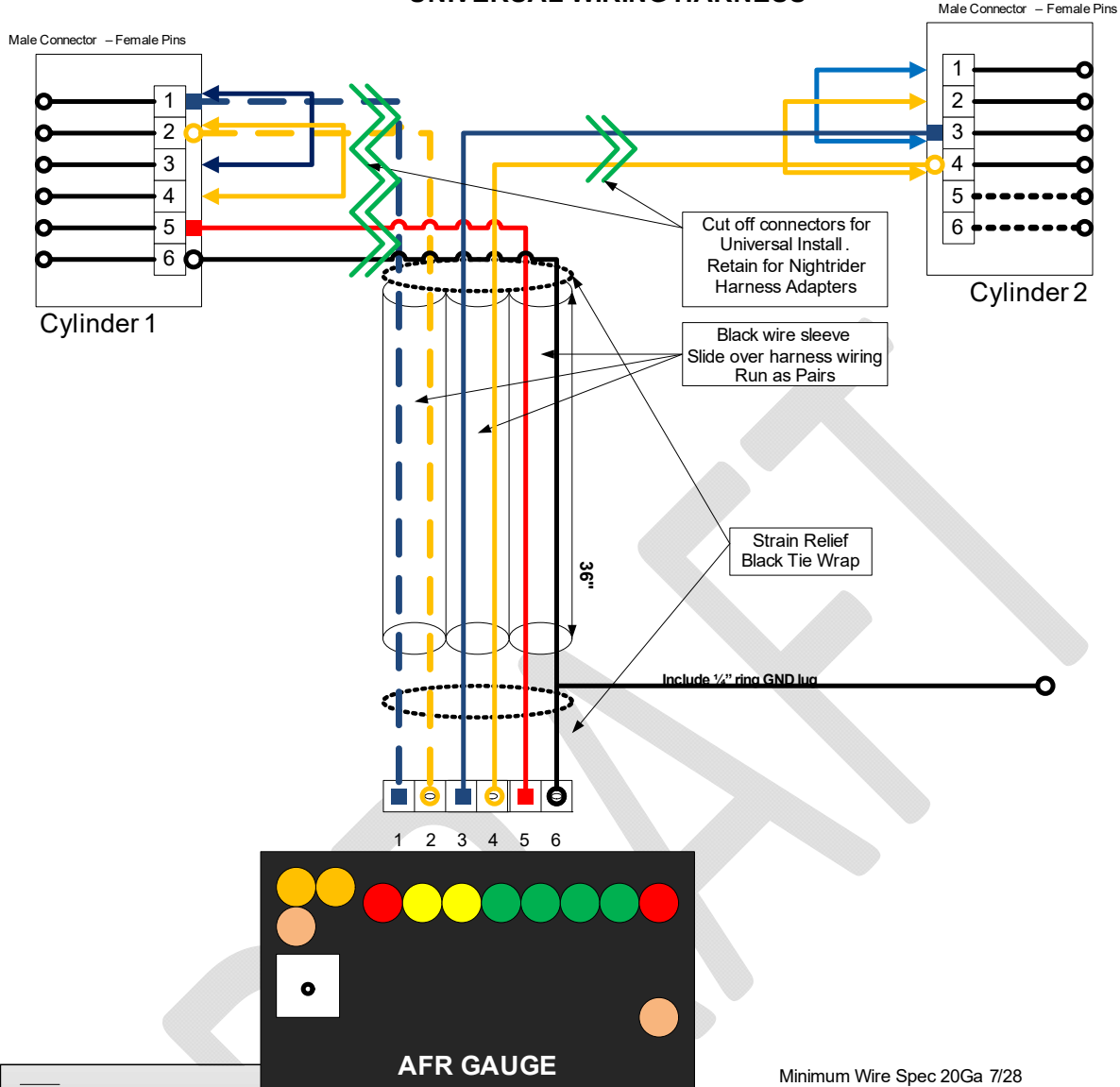
- No LED – very lean
- Left RED - lean
- YELLOW – normal idle/cruise
- GREEN – cruise/accelerate
- Right RED – accelerate/100% throttle
- Double RED – 100% throttle/very rich
- Right RED + GREEN – High Voltage (ECM/O2 Error)

### MODE Indicators

- Cyl 1 or Cyl 2 LED indicate cylinder
- Cyl 1 and Cyl 2 LED on for Average
- 2-wire LED ON – Upstream Sensor (2-wire)
- 2-wire LED OFF – Downstream Sensor (4-wire)
- Cyl LED and 2-wire Fast Blink – Voltmeter
- 2-wire Blink – History Replay

Figure 3

# AFR Gauge UNIVERSAL WIRING HARNESS



To O2 Sensor Wiring  
AFR Board

- 1 – C1IN In (+) White/Blue – Front or Right
- 2 – O2-1 In (-) Yellow/Orange - GND
- 3 – C2IN In (+) Blue – Rear or Left
- 4 – O2-2 In (-) Yellow - GND
- 5 - +12V Red
- 6 – GND Black

Universal Wiring Harness  
Female Connector  
Male Pins

Connect with "T-Tap" only  
Used Switched +12V  
-Ignition Switch  
or  
-+12V 4-wire O2 sensor

Minimum Wire Spec 20Ga 7/28  
SAE J1128 GXL or SXL (125C)

6-pin Female Connector/Male Pins  
Molex Series 1261

03-09-2061 Female

03-09-1061 Male

[http://www.molex.com/pdm\\_docs/sd/003091061\\_sd.pdf](http://www.molex.com/pdm_docs/sd/003091061_sd.pdf)

Ground Lug w/strain relief  
Molex Perma-Seal terminal

Wire Sleeve UL 224  
125C operating temp  
OD .125-.250"

<b>Nightrider.com</b>		
AF-GAUGE	1/18/2016	Universal

Figure 4

## USING THE AFR GAUGE

There are general characteristics and guidelines for tuning an engine. Listed below is common tuning information for street engines. This would include stock vehicles and those with exhaust and/or air cleaner upgrades. This also includes most engine kits from an OEM manufacturer because these would be emissions compliant. True high performance and race engines built by specialty builders will typically require more fuel.

Maximum power for normally aspirated engines can generally be developed with AFR's in the 12.8-13.4:1 range.<sup>1</sup>

We do not recommend Fuel Ratios richer than 13.0:1 for idle/cruise do to an increased risk of cylinder wash.<sup>2</sup>

### Fuel Value Characteristics<sup>3</sup>

- |   |                         |
|---|-------------------------|
| • 11.5 AFR - Best Rich Torque at Wide Open Throttle | RED/RED                 |
| • 12.2 AFR - Safe Best Power at Wide Open Throttle  | YEL/YEL/GRN/GRN/GRN/GRN |
| • 13.3 AFR - Lean Best Torque                       | YEL/YEL/GRN/GRN         |
| • 14.6 AFR - Stoichiometric AFR (Stoich)            | YELLOW / YELLOW         |
| • 15.5 AFR - Lean Cruise                            | RED                     |
| • 16.5 AFR - Usual Best Economy                     | RED                     |
| • 18.0 AFR - Carbureted Lean Burn Limit             | No LED                  |
| • 22.0+ AFR - EEC / EFI Lean Burn Limit             | No LED                  |

### Lean Engine Characteristics

- Hotter Engine Temperatures
- Detonation
- Engine Ping
- Poor Throttle Response

### Rich Engine Characteristics

- Poor Gas Mileage
- Decel Popping / Backfire
- Poor Throttle Response
- Black/Sooty Exhaust
- Carbon Buildup in Engine
- Fuel Smell from exhaust

### General AFR Ranges for street engine operation

- |                 |                                 |
|-----------------|---------------------------------|
| • DECELERATION  | 15.5 – 14.6:1 (Single RED LED)  |
| • IDLE (hot)    | 15.0 – 14.6:1 (YELLOW LEDs)     |
| • CRUISE        | 14.6 – 14.0:1 (GREEN LEDs)      |
| • ACCELERATION  | 14.0 – 13.0:1 (GREEN LEDs)      |
| • FULL THROTTLE | 13.0 – 11.0:1 (Double RED LEDs) |

<sup>1</sup> "Motorcycle Engine Management Systems", Tracy Martin, page 59, Motorbooks Publishing

<sup>2</sup> "Engine Management Advanced Tuning", Greg Banish, page 53, Car Tech Publishing

<sup>3</sup> <http://www.afrplus.com> Dobeck Performance

## INSTALLING THE AFR GAUGE

The Nightrider.com Advanced AFR Gauge has three 'pair' of connections. One set of wires is for +12V Power, another for the first cylinder NBO2 connections (used for single O2 sensor installation) and a third pair of wires for the second O2 sensor. The AFR Gauge comes with a wiring harness connector designed for use with a variety of Nightrider.com AF-XIED Harness Adapters. These Harness Adapters plug between the O2 sensor and OEM wiring harness. If you have a Nightrider Harness Adapter installed, you simply need to plug the AFR Gauge connector(s) to the Harness Adapter connector. Only the Cylinder 1 connection supplies power to the AFR Gauge.

If there is no Harness Adapter available for your vehicle, you can order a Universal Harness Adapter for quick install and removal of the AFR Gauge. It is also to cut the white connectors off the AFR Gauge harness and wire directly to your vehicle.

All that is required to connect the AFR Gauge into the vehicle wiring harness are simple wiring taps like Scotch Lock crimps and ¼" spades. You will need to properly identify the following wires on your vehicle.

- O2 Sensor (+) – Cylinder/Bank 1  
Blue/White wire
- O2 Sensor (-) – Cylinder/Bank1  
Yellow/White wire
- +12V Power – from Heater (+) or switched +12V  
RED wire
- Power Ground – To battery Negative Terminal or Chassis Ground  
Black wire
- O2 Sensor (+) – Cylinder/Bank 2  
Blue wire
- O2 Sensor (-) – Cylinder/Bank2  
Yellow wire

Since the wires are 'paired' individually, Universal installation will be simple. The standard wire length is 3 foot with an optional 8 foot harness available. The AFR Gauge comes with industrial Velcro, allowing quick mounting on any clean, flat surface.

## TROUBLESHOOTING

No Power indicated (Power LED not on)

- Make Sure the +12V source is working
- Check your ground

No Active LED Display

- Verify O2 sensor signal connection is correct  
Verify O2 sensor signal ground is correct
- Verify MODE switch is set between 0 and 8, and for correct cylinder/bank

No History Display

- Did You go to history mode (9) within 20 seconds of vehicle run

DRAFT

## ACCESSORIES

- Standard 3 foot Universal with Nightrider Plug-n-Play Harness Adapter Included in Kit
- Nightrider AFXIED “in-line” adapter
  - Harley-Davidson 2007>Later
    - 2-wire Bosch (not heated)
    - 4-wire Delphi (heated)
  - BMW R1150,R1200,F-bikes,K-bikes
    - BMW R1200 style 4x1 pin Oval connector
      - R1200, F-models, K-models
    - BMW R1150 style 2x2 pin Round connector
      - R1150, select R1100 models
    - BMW R1100 uses Universal Harness
  - INDIAN
  - Buell
  - Victory
  - Ducati
    - Ducati 4x1 pin rectangular connectors
    - Ducati 2x2 square connectors
  - Husqvarna
    - BMW R1200 style connectors
- Eight (8) foot Universal Harness
- Nightrider Plug-n-Play harness for AFR Gauge
  - Any Vehicle listed above
    - AFR Gauge plugs directly into Harness Adapter

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## DISCLAIMER

Actual results from the installation of the Advanced AFR Gauge may vary between individual vehicles. While an NBO2 will never match the accuracy of a wide band sensor, this Copyrighted design provides extremely accurate feedback of the fuel mixture.

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<sup>i</sup> Nightrider.com Advanced AFR Gauge specifications and documentation are subject to change prior to full production release.