VEI Systems Installation Instructions
D1-BOB-WBA-Mx – Dual Gauge – Vacuum-Boost & Wideband Air-Fuel Ratio

Please read these instructions completely before beginning installation to ensure that you have the tools and skills necessary for installation and operation of this instrument. If you are not sure that you can perform the installation safely, then consult a qualified installer. Further instructions available at www.VEISystems.com/technical.html .

FEATURES

This dual-function instrument monitors engine intake manifold vacuum-boost pressure and wideband air-fuel ratio simultaneously on two independent displays within a single gauge housing. The vacuum-boost function displays negative values (vacuum) in inHg and positive values (boost) in Bar.

For wideband air-fuel ratio, the gauge accepts a linear analog signal of 0 to 5 volts and displays this as any linear range of values in one of 3 ranges: 0.00 through 9.99, 0.0 through 99.9, or 0 through 999. The specific linear range (displayed output) is user-programmable into the gauge, and can have a positive or negative slope. In other words, the displayed value at 5V can be lower than the displayed value at 0V. You only need to set the 2 endpoints of the line, and the gauge will interpolate the rest depending on th e input received at any time. The wideband function also has powerful user-adjustable software-filtering levels. The gauge will store the endpoints, and other relevant settings in non-volatile memory, such that the gauge will still remember the user settings even if the battery is disconnected.

MOUNTING

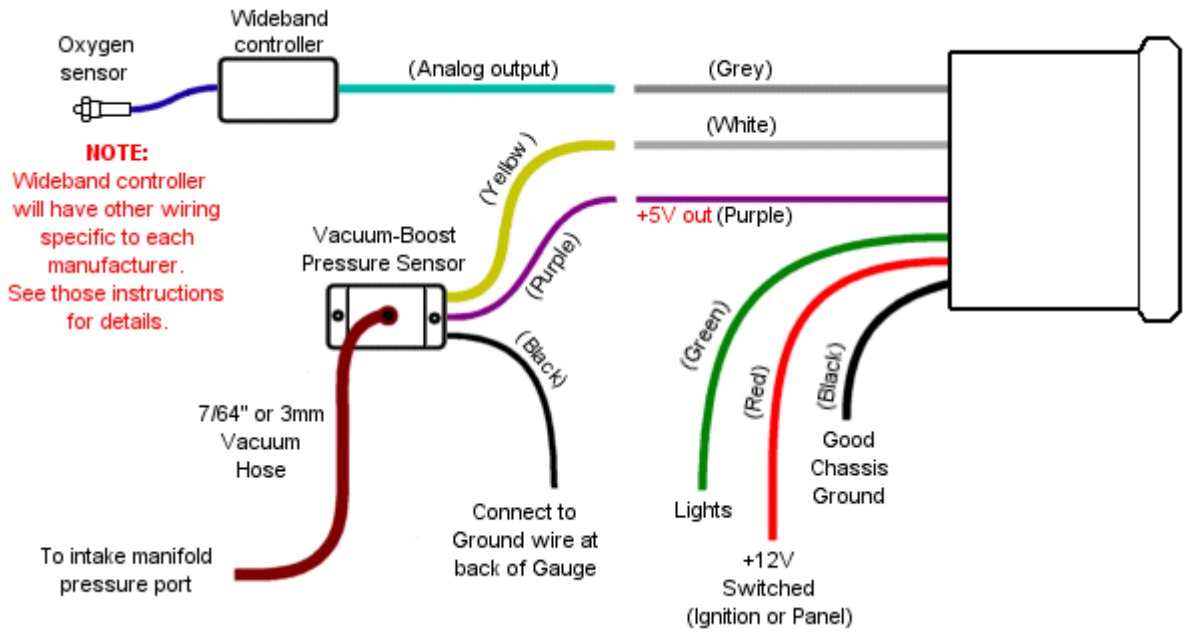
Install the unit through the front of the mounting hole in the dash pod or panel. If you are making a custom dash panel, you will need to drill a 2-1/16" hole. Slide the clamp onto the 2 studs on the back of the instrument. Secure with the 2 thumb-nuts. Use a small drop of threadlocker or nail polish on the thumb-nuts to prevent them from loosening under vibration.

For vacuum-boost pressure, use sender SEN-P70B. Mount the sender behind the dash (preferred) or on a relatively cool part of the engine bay, such as in the ECU-box, behind a secondary firewall (if the vehicle has one) or behind a fenderwell. Make sure it will not come in contact with water or other fluids. Secure it to the mounting location with 2 screws (#6, #8 or M5) or attach with adhesive tape or velcro.

For air-fuel ratio, install the oxygen sensor and controller as per the instructions supplied with that.

WIRING

The wires should be connected as below using crimp-on butt-splice connectors, or soldered and sealed with heat-shrink tubing. Before connecting any wires, you should either disconnect the battery power, or carefully connect the wires in the order shown. If not, you may damage the instrument. Use an existing fuse in the fuse panel, or an external fuse to supply power to the instrument. The D1 series instruments use approx. 130mA of current average and approx. 210mA maximum, so ensure the fuse is sized appropriately. For a single gauge, a 0.5 Amp or 1 Amp fuse is good. For a typical 6- or 7-gauge setup, a single 5 Amp fuse is good.



- BLACK (on gauge) -- connect to the vacuum-boost pressure sender and then to a solid chassis ground under the dash or directly to the battery. You may need to expose the metal connection point under the dash by scraping or lightly sanding it. A ring terminal and a screw should work well in most cases.

- RED -- connect this to a source of **switched** +12V power. This will usually be found at or near the ignition switch, and will usually have a relay wired through the ignition switch. An alternate source of this is a switched power line from a nearby light or accessory (radio, etc). If you are unsure that the wire can support the power required for the instrument, then use an external relay.

- GREEN – connect this wire to the positive line (+12V) from the headlight switch. When this line receives a positive voltage, the gauge will use the "park-lights" brightness setting. Alternatively, if setting up a racing-mode display, this can be connected to a separate mode switch (12V or 0V signal).

- WHITE – This is the Channel-1 (upper display) input for the Vacuum-Boost sensor. Connect this wire to the Yellow output wire on the vacuum-boost sender.

- GREY – This is the Channel-2 (lower display) input for the wideband controller. Connect this wire to the analog output wire on the wideband controller.

- PURPLE – This is the 5V output to the vacuum-boost sensor. Connect this wire to the purple (or red) wire on the vacuum-boost sender. CAUTION, this wire supplies a positive voltage to the vacuum-boost sender – it must NOT be accidentally allowed to touch any other wire.

VACUUM-BOOST SENSOR:

- BLACK -- connect to a solid chassis ground under the hood, or directly to the battery. Ideally, connect it to the same ground point as the gauge. You may need to expose the metal connection point under the hood by scraping or lightly sanding it. A ring terminal and a screw should work well in most cases.

- PURPLE -- connect this to the purple wire on the gauge (which supplies +5V to this sensor). DO NOT connect this to +12V as this will damage the sensor.

- YELLOW– this is the output signal of the densor. Connect it to the white input wire on the gauge (channel 1).

OPERATION

There are 2 settings "sections" – one for ambient calibration / wideband data-point configuration, and the other for general operational settings.

The ambient calibration / data-point configuration should be performed first as follows: with the ignition key off, press the button on the gauge and hold it down. While down, turn the ignition key to the ON position (do not start the vehicle) so that the gauge powers up. It will first perform the ambient calibration routine – it will display a sequence of dots on the display while acquiring the data, then it will show "End" on the display to indicate that the ambient pressure level has been acquired and recorded. (You should perform this calibration when ambient pressure level changes significantly, such as when the vehicle is driven to a higher altitude. If the gauge does not read zero with the engine off, this is an indication that the ambient-calibration procedure needs to be performed).

Continue to hold the button down, then it will display "Cfg" to indicate that it is now in the data-configuration mode.

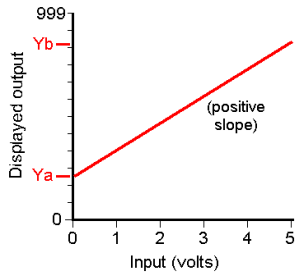
Data Configuration:

Here you will set the endpoints for the linear equation data-points to be displayed, the range, and the software-filtering level. In this data-configuration section, press and hold the button for a few seconds to change the mode. Press and release quickly (tap the button) to change the setting in any mode. Some of this may take time, so plan everything first and you'll save yourself some hassles – you should only have to do this once. Data configuration modes are as follows:

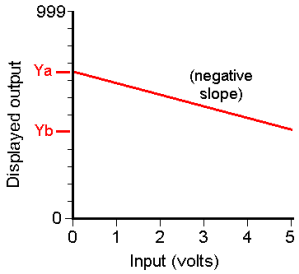
MODE	DISPLAY	SETTINGS
Channel swap	Ch1 / Ch2	Allows you to swap the position of the upper & lower displays if required.
Set range of lower display	0.00	Tap button to select between the range – either 0.00 to 9.99, 0.0 to 99.9 or 0 to 999.
Set 0V endpoint of lower display	Ya	Sets the Y-value (output/display value) represented by an input voltage of 0V.
Set 5V endpoint of lower display	Yb	Sets the Y-value (output/display value) represented by an input voltage of 5V.
Set software filter level of lower display	IIr	Sets the filter level from 1 (soft/slow) to 15 (hard/fast), or off.

Note that in the table above, the upper display is also called channel 1 and the lower display is called channel 2, or vice-versa if the channels have been swapped in the user-settings (explained in the general configuration section below). For each of the two channels, the graphs below show example linear equations that can be setup on the gauge. The equation-set for one gauge is shown for simplicity:

Example 1: Range = 999
Ya = 208
Yb = 834



Example 2: Range = 9.99
Ya = 7.07
Yb = 4.16



Filtering:
On any signal line within an automobile, there will be electrical noise present. The firmware within the gauge samples (electronically reads) the input data hundreds of times per second, and averages a few of these at a time to cancel out the effects of noise. However, the noise level may vary depending on the specific vehicle and installation. Due to it's high sensitivity (for maximum accuracy), and its high sample rate, some of this noise will be shown on the gauge as “flickering” or “toggling” numbers (rapid oscillation between two or more values, usually on the lowest-value digits). But depending on the data being measured, you may not need high update rates and may wish to use more filtering. An example of this is measuring the liquid level in a bucket that is moving, where you don't want the gauge to respond to every change in the sensor value as the liquid sloshes around, but rather you're interested in the average liquid level.

The gauge has very powerful IIR software filtering internally, which essentially “dampens” the change of the current input value from the last input value, so that the gauge takes longer to settle to the new value. The IIR filter level is adjustable from 1 to 15 of off, where the higher the number, the less filtering and hence quicker updates. Switching the filter off provides the data change rates. For gauges such as voltmeters, tachometers and boost gauges, less filtering (higher IIR values) are more desirable; for air-fuel ratio gauges, mid-level filtering works well, and for temperature gauges, speedometers or liquid level, more filtering (lower IIR values) generally work better.

Example Wideband-Controller Setup Values:
For a wideband controller with 10.0:1 AFR at 0 Volts and 20.0:1 AFR at 5 Volts, you would set Range to 99.9, Ya=10.0, Yb=20.0, and IIR should be set to a low value such as 1 to 4.

For a wideband controller with 7.4:1 AFR at 0 Volts and 22.4:1 AFR at 5 Volts, you would set Range to 99.9, Ya=7.4, Yb=22.4, and IIR should be set to a low value such as 1 to 4.

For controllers that do output 0 to 4 Volts, project the equation to the 0V and 5V points. For example, for a wideband controller with 10.0:1 AFR at 0 Volts and 20:1 AFR at 4 Volts, you would project the 5V value to 22.5, then set Range to 99.9, Ya=10.0, Yb=22.5, and IIR should be set to a low value such as 1 to 4.

General Configuration:

Once the data points have been set, you can continue around back to the first data-configuration mode, or you can switch the ignition key off and then back on, to get it to normal operation mode where you can access the remaining general modes/settings. Press and hold the button for a few seconds to change the mode. Press and release quickly (tap the button) to change the setting in any mode. Modes are as follows:

MODE	DISPLAY	SETTINGS
Normal	(Pressure)	Shows oil pressure in upper display and fuel pressure in lower display, unless display channels were swapped (explained below).
Channel swap	Ch1 / Ch2	Allows you to swap the position of the upper & lower displays if required.
Brightness Regular	Br . 9	Last digit shows regular brightness level from 1 to 9.
Brightness park-lights on	BP . 1	Last digit shows brightness level with lights on from 1 to 9.

WARRANTY & LIABILITY

Neither VEI Systems, nor its dealers or agents shall be liable in any way, for any damage, loss, injury or other claims, resulting from the installation or use of this product. By purchasing or installing this product, you assume all liability of any kind connected with the use and/or application of this product. If you are unsure that you can safely install and use this product, consult a qualified installer or mechanic. The warranty on this product covers only the product itself for a period of 1 year from the date of purchase, and it will be at our discretion to repair or replace the affected parts. No user serviceable parts inside. Warranty void if product enclosure opened.