

LCD BOOST CONTROLLER

(for reading AEM EMS Telemetry)

The purpose of this device is to regulate the turbocharger boost, make tuning easier to monitor, reduce the clutter in your interior (ie. separate boost guage, WBO2 displays, etc) and save some money by consolidating many devices into one. This edition of LCD Boost Controller communicates with an AEM EMS (Series 1 or 2) through serial telemetry, allowing the end user to view many parameters. This LCD Boost Controller hardware is the exact same as the one used for reading OBD1, MUT/OBD2 allowing flexibility in case your needs change. Only the software needs reflashing to switch over.

SETUP CONFIG

To enter config menu, press and hold down on knob and then power up the device. Release when you see the Copyright message displayed on the screen. It will soon flash the message Config Menu and the software version number.

CustomX Selected X represents which custom screen (1-9) is to be edited for the following nine setup config menus (Custom String Edit, Scalar Positive/Negative, Scalar Numerator, Scalar Denominator, Offset Positive/Negative, Offset Numerator, Offset Denominator, Signed, Decimals places).

Custom String Allows the user to rename the Custom 00X string into more meaningful, such as EGT 1, WBO2, Boost, etc.

Scalar=Positive The scalar is a positive (+) number.

Scalar=Negative The scalar is a negative (-) number.

Scalar Numerator This number represents the top half of the fraction, 5 digits maximum. To input a number such as 28, it should be entered as 00028.

Scalar Denominator This number represents the bottom half of the fraction, 8 digits maximum. To input a number such as 12345, it should be entered as 00012345. In most instances this value will be one.

Offset=Positive The offset is a positive (+) number.

Offset=Negative The offset is a negative (-) number.

Offset Numerator This number represents the top half of the fraction, 5 digits maximum. To input a number such as 28, it should be entered as 00028.

SETUP CONFIG continued...

Offset Denominator This number represents the bottom half of the fraction, 8 digits maximum. To input a number such as 12345, it should be entered as 00012345. In most instances this value will be one.

Signed=No This means the data arriving from the serial stream represents positive numbers only (not to be confused with the final calculated data that may be negative).

Signed=Yes This means the data arriving from the serial stream represents both negative and positive numbers.

Decimals=X X represents how many decimal places the final answer should be displayed as. In most cases this be 0. If you're monitoring small numbers such as narrowband O2 voltages, it should be set to 2 decimal places (ie. 0.47).

Reset Customs=Yes/No Erases ALL customs 1-9 data and replaces it with factory default settings.

ScreenRefresh=xx. Think of this as a screen refresh delay. A low number updates the LCD screen with new data quickly, and a high number updates the screen less frequently. During the winter months you might want to increase this number because LCD screens are sluggish in the cold.

Contrast=50. Adjusts the contrast display, low value=darker, high value=lighter. If the display flickers, the contrast value is set too high, go to a lower number.

Custom LED Color. Allows the user to make a custom LED color based on different values of Red, Green and Blue intensities.

Push to toggle color. Sets the power on default color: Red, Green, Blue, Purple, Cyan, Yellow, White or none.

SETUP CONFIG continued...

PSI Sensor= Intrnl. Uses internal pressure sensor 0.0psi to 36.3psi, vacuum is not measured.

PSI Sensor= Gr4Bar Uses external 4 BAR greddy pressure sensor (vacuum to 43.5psi).

Tested to work with the original Greddy pressures sensor, and black plastic clone version too. The silver metal clone version does not work.

PSI Sensor= GM3Bar Uses external 3 BAR GM pressure sensor (vacuum to 32psi).

PSI Sensor= 2.5Bar Uses internal pressure sensor through the external interface.

PSI Sensor= Serial Uses AEM EMS map sensor via serial data stream. This will read the results computed from Custom001.

PSI Add step = xx. If your external pressure sensor reads map pressure instead of gauge pressure, and it bugs you that you don't see 0.00 PSI, use this to correct your reading to 0.00.

WBO2 input= Serial Read WBO2 data from serial stream (Future feature).

WBO2 input =wire Use this if your WBO2 wire is wired directly to the device (preferred method).

WBO2 input =none If you have no WBO2 at all, set this to none and the main screen will switch to NBO2 (narrow band O2) and display the front O2 sensor voltage.

WBO2 low = 10 Set the lowest AFR value that your wideband reads.

WBO2 high= 20 Set the highest AFR value that your wideband reads.

WBO2 factor=1.00 Multiplies the WBO2 wire by this value . In case of weak signal use this.

WBO2 offset=0.0 Adds a small correction value to your WBO2 results.

SETUP CONFIG continued...

Aux input= latch. If the auxiliary input receives a ground signal, it will remain triggered until the device is powered off. Example usage: Water/Alchy injection fluid level indicates low fluid or empty, the Aux will remain triggered and Aux Duty Cycle can reduce boost to preset safe level.

Aux input= normal. When auxiliary input receives a ground signal, it only stays triggered while the ground signal is present. Example usage: Toggle switch that selects low/high boost. Low boost could be used for Valet mode.

Knock Alert > x.xx. If knock#1 volts exceeds this voltage threshold, it will warn the driver with a flashing screen. Audio alert will only sound during knock.

CoolantAlert > xxx. If coolant temperature exceeds this threshold, it will warn the driver with a flashing screen, and audio alert will sound.

AudioBuzzer=On. Allows device to use audio buzzer to get driver's attention.

AudioBuzzer=Off. Turns off audio buzzer completely.

Test solenoid Activates boost solenoid at 50% duty cycle for 2 seconds.

Test Buzzer Activates audio buzzer for 1 second.

Calibration=xxx Factory calibration that influences serial communication speed.

Units = Imperial – temperature in degrees Fahrenheit and boost in PSI.

Units = Metric – temperature in degrees Celsius and boost in BAR.

Push to exit config menu – quits the config menu and takes you to normal operation.

Using AEM EMS pressure sensor and WBO2 via serial data stream.

To use the AEM EMS own pressure sensor readings, we must define Custom001 as Boost.
Example below assumes we are using an **AEM 3.5bar sensor**.

1. On AEM EMS configure Serial telemetry byte #11 to MAP VOLTS (Custom 001). Save results.
2. Enter setup config on boost controller.
3. Select Custom1 (default).
4. Change Custom001 string to Boost.
5. Scalar=Positive (default).
6. Scalar Numerator 00125
7. Scalar Denominator 00000502
8. Offset=Negative.
9. Offset Numerator 02095
10. Offset Denominator 00000100
11. Signed=No (default).
12. Decimals=1
13. PSIsensor=Serial

To use the AEM EMS WBO2 results, we must define Custom002 as WBO2.

Example below assumes we are using one of the following (**AEM 30-5130, AEM 30-2310, or AEM 30-2340**). **Min AFR=7.31, Max AFR=19.18**

1. On AEM EMS configure Serial telemetry byte #12 to O2#1 (Custom 002). Save results.
2. Enter setup config on boost controller.
3. Select Custom2.
4. Change Custom002 string to WBO2.
5. Scalar=Positive (default).
6. Scalar Numerator 11875
7. Scalar Denominator 00255000
8. Offset=Positive (default).
9. Offset Numerator 73125
10. Offset Denominator 00010000
11. Signed=No (default).
12. Decimals=1
13. WBO2 input=Serial

Using AEM EMS pressure sensor and WBO2 via serial data stream (continued...)

To use the AEM EMS WBO2 results, we must define Custom002 as WBO2.

Example below assumes we are using **PLX-M** wideband. **Min AFR=10.0, Max AFR=20.0**

1. On AEM EMS configure Serial telemetry byte #12 to O2#1 (Custom 002). Save results.
2. Enter setup config on boost controller.
3. Select Custom2.
4. Change Custom002 string to WBO2.
5. Scalar=Positive (default).
6. Scalar Numerator 00010
7. Scalar Denominator 00000255
8. Offset=Positive (default).
9. Offset Numerator 00010
10. Offset Denominator 00000001
11. Signed=No (default).
12. Decimals=1
13. WBO2 input=Serial

To use the AEM EMS WBO2 results, we must define Custom002 as WBO2.

Example below assumes we are using **Innovative LM1** wideband. **Min AFR=7.32, Max AFR=21.9**

1. On AEM EMS configure Serial telemetry byte #12 to O2#1 (Custom 002). Save results.
2. Enter setup config on boost controller.
3. Select Custom2.
4. Change Custom002 string to WBO2.
5. Scalar=Positive (default).
6. Scalar Numerator 57188
7. Scalar Denominator 01000000
8. Offset=Positive (default).
9. Offset Numerator 00732
10. Offset Denominator 00000100
11. Signed=No (default).
12. Decimals=1
13. WBO2 input=Serial

OPERATION OF DEVICE

When powering up the device, it will take you immediately to the main screen.

The default main screen is shown below:

14.7	0.0	0.00
WBO2	PSI	KNOCK

First value shows the wideband O2 AFR. The second value is the pressure sensor in PSI. The third value is knock #1 volts reported from the AEM EMS serial stream.

Pressing down on the knob quickly will dim the screen (good for night time driving), pressing it again will brighten the screen. This function only works on the main screen.

Pressing down on the knob for half second or more will toggle it from normal, Red color shift, Green color shift, Blue color shift, stop. This is for entertainment purposes only, allowing you to see some possible color combinations as it cycles up and down.

To navigate to other screens use the rotary knob. Turning the rotary knob clockwise will display AEM EMS related screens and turning counter-clockwise will show boost controller menus. To edit information, you must push down on the knob and the screen characters will go into capital characters to let you know that you're in edit mode. To exit edit mode, press down on the knob again or follow the instructions on the screen.

BOOST CONTROLLER MENUS

xx.xPSI Peak

xx Knock Peak

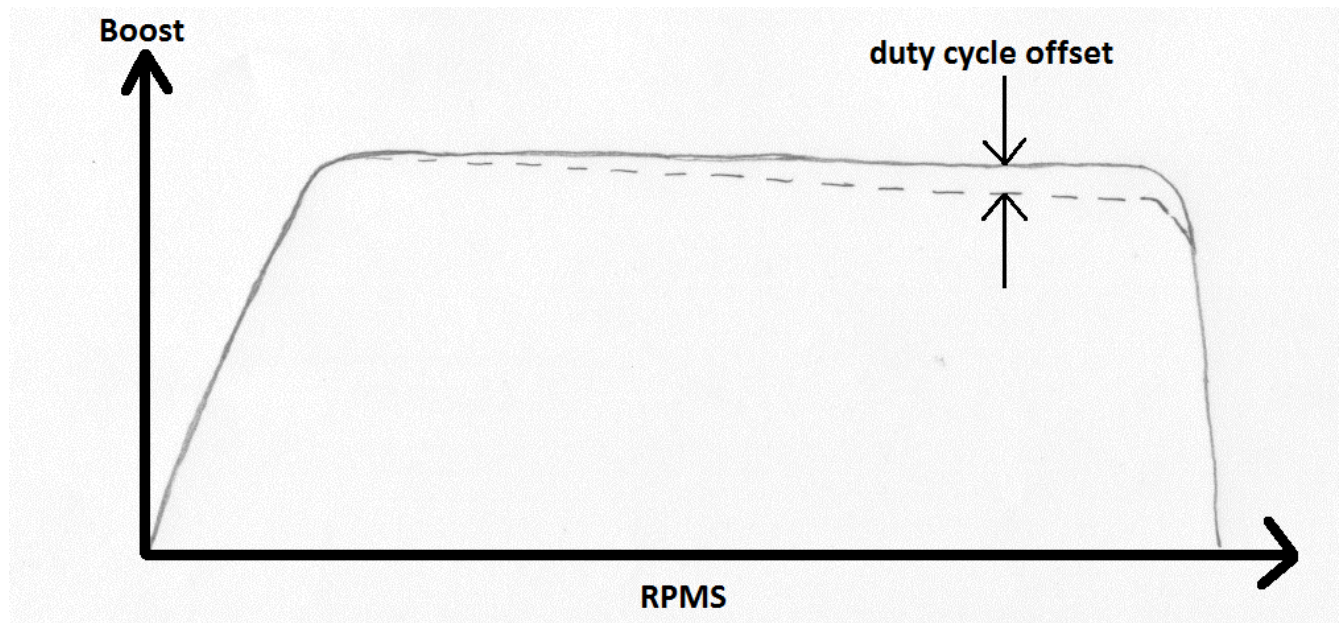
Displays highest recorded boost pressure and knock values. To the right you may notice a small graph. It's a small datalog of PSI vs RPMs. The PSI scales from 1 to 17psi. Because the display is not a graphics display but a character display, the scale for 9psi will be absent. You can easily see your boost response curve. By pressing down on the knob, you reset the values.

Dutycycle=xx.x

This works just like many electronic boost controllers out there. Small duty cycle numbers gives you low boost, large duty cycle numbers gives you high boost. Start off with small numbers and gradually work your way up. Examples: 30% duty cycle=10 PSI, 50.0% = 18 PSI on my 15G turbos.

Dutycycle offset (adjust boost curve)

Allows you to add or subtract duty cycle based on RPM, starting at 4000 RPMs, 4500 RPMs, etc. Add duty cycle if you have wastegate creep problem, subtract duty cycle if you have boost creep problem. The picture below shows an example of wastegate creep problem with boost falling off at higher RPMs (dotted line). By introducing extra duty cycle, the boost curve becomes more consistent (solid line). Here's the values I used on my car. 4000 +0, 4500 +0.6, 5000 +1.3, 5500 +2.0, 6000 +2.6, 6500 +3.3, 7000 +4.0, 7500 +4.0, 8000 +4.0.



BOOST CONTROLLER MENUS continued...

Alarm Boost=xx.x PSI

When boost reaches this amount or more, the boost solenoid will shut down for 1 second, reducing turbo boost pressure to wastegate levels. An overboost warning message along with peak offending boost pressure will be displayed for 5 seconds. An audible alert will only be heard if boost is above alarm boost preset. Should the driver ignore the warnings, and because the boost solenoid is only shut down for 1 second, it is quite possible for the driver to experience a bouncy boost (high boost, low boost, high boost, low boost).

Dutycycle temp

This compensation allows you to add or subtract duty cycle based on temperature readings from the MAF. All boost solenoid are slightly influence by temperature. Instead of the driver compensating for weather changes, it would make sense for this to be automatic. Here's the calculated values I have setup on mine, 20F -3%, 50F -1.5%, 80F 0%, 110F +1.5%, 140F +3%.

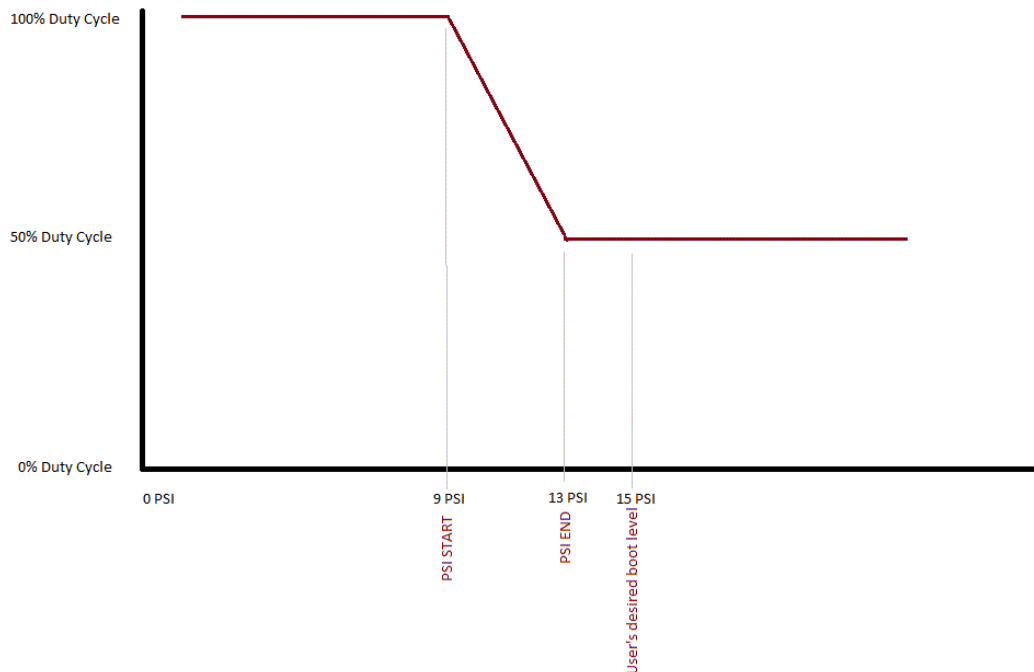
Aux Duty =xx.x

When the auxiliary input is triggered by a ground signal, the aux duty cycle is added to the overall duty cycle. So for example, if Aux Duty is set to -10.0 and duty cycle=50.0 the result would be 50-10=40. This feature can be used to run a high/low boost setting with a switch, or low boost for valet mode. Another use is when water/alchy is low on fluid, is for the boost controller to automatically switch to low boost mode. A latching option should be also set in the config menu for boost to stay in low boost mode until device is powered off.

BOOST CONTROLLER MENUS **continued...**

PSI Start=xx.x

Default set to 1.0 PSI. This parameter allows your turbocharger(s) to spool up more quickly by delaying the opening of the wastegate. By keeping the wastegate completely closed the turbocharger reaches your desired boost pressure sooner. Having an on/off approach as some electronic boost controllers use can easily create boost spikes, so we use two parameters to ramp in this change and the boost spike problem is gone. “PSI Start” is where the ramp begins, and “PSI End” is where the ramp change is completed. For a more aggressive spool up increase the PSI Start parameter.



PSI End=xx.x

Default set to 2.0 PSI. The stock wastegate spring is 6psi on the 3S vehicles, and with a default value of 2.0 PSI any spool up assistance is effectively off. To turn on spoolup assistance, this value must be increased past 6 psi to realize any spool up gain. For example, if you want 18psi as your target boost value, I would suggest using “PSI END=16.0”. This means anything below 16PSI is using a higher duty cycle temporarily to assist in spool up, however when it reaches past 16PSI it is using your normal target duty cycle numbers. If you want to be more aggressive try increasing the “PSI Start” value too.

AEM EMS ECU INFORMATION

Engine RPMS **xxxx**
Throttle **xxx.x%**

Engine RPMS are displayed in increments of 25.
Throttle TPS sensor represents percentage of throttle open.

Air Intake **xxxF**
Coolant **xxxF**

Air Intake represents temperature of incoming air.
Coolant represents temperature of engine.
Can be displayed in units of Fahrenheit or Celsius.

Knock#1 **x.xxV**
Timing **xx.xdegrees**

Shows Knock #1 voltage, and timing numbers.

Battery **xx.x V**
Inj.Pulse **xx.x ms**

Battery voltage at the ECU connector.
Injector fuel pulse open in terms of milliseconds.

Engineload **xxx.x%**
Inj.Duty **xxx.x%**

Engine load from 0-100%.
Fuel Injector duty cycle 0-100%.

AEM EMS ECU INFORMATION continued...

Custom 001 xxxxxxx

Custom 002 xxxxxxx

There are nine custom screens for the user to program in (ie. EGT 1, WBO2, etc). The alphanumeric string can contain up to 10 characters. The numeric data is 6 digits long and is customizable by the user including the number of decimal places the final answer to be displayed.

OVERBOOST MESSAGE

Should you accidentally exceed your Alarm Boost setting, you will receive an overboost message flashing in red along with the peak overboost in PSI. The solenoid will shut down for 5 seconds dropping your boost down to wastegate pressure.

UPGRADING SOFTWARE

There are two ways of upgrading software. The first method is to use a PC with a serial port and using a null-modem serial cable, or a null-modem adapter and a regular serial cable. Plug the cable to the back of the black box and run the software I provide for flashing. The entire process takes about 60 seconds or less. The second method involves purchasing another microprocessor with the new software loaded and swapping. Swapping is made easy because the microprocessor sits on a socket so no soldering required.

SOURCING BOOST SOLENOIDS

Go on www.ebay.com and search for “*AEM boost solenoids*”. I found one vendor selling them for \$25 + \$5 shipping that included brass fittings. These AEM boost solenoids are manufactured by Mac valves (part number 35A-AAA-DDBA-1BA). You can also purchase these boost solenoid directly from www.macvalves.com for \$17.50.

DISCLAIMER

Increased turbo boost pressure could harm your engine and/or turbocharger, the user assumes full responsibility for any damages that may occur.